THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

VOL. XXXII AUGUST, 1934 No. 2

INTERPRETATION OF VENTRICULOGRAMS*

WITH SPECIAL REFERENCE TO TUMORS OF THE TEMPORAL LOBE

By A. TORKILDSEN, M.D., *and* A. H. PIRIE, M.D.

OSLO, NORWAY MONTREAL, QUEBEC

VENTRICULOGRAPHY and encephalography as methods of investigating cases of diseases of the central nervous system are rapidly becoming more frequently used. Originally introduced by a neurological surgeon[2] and employed by neurological surgeons,[3,4,5] these operations are now also performed by neurologists independent of any surgeon.[1] The danger connected with these procedures should interdict this practice. However, the use of pneumography has become universal and neurologists as well as roentgenologists are at the present time so frequently faced with the difficult task of studying ventriculograms that a more perfect knowledge of their interpretation has become necessary.

By ventriculogram is understood the film which is taken after air or oxygen has been introduced directly into the ventricles by means of a small burr opening in the skull. All the injected gas is, in such a case, within the ventricular cavities.

The name encephalogram indicates that the gas has been injected by lumbar puncture, most frequently performed in the third or fourth lumbar interspace. The patient is placed in a sitting position so that the injected gas ascends to the fourth ventricle where one part of it enters the ventricular system through the foramina of Luschka and Magendie while the other part of the gas ascends higher and fills the subarachnoid space covering the hemispheres, thus outlining on the film the intergyral spaces and the various cisternae as well as the ventricles.

Each of the two methods as well as the choice of gas has its special indications and contraindications.

In order to obtain a true picture of the ventricles, one must be certain that the part in question is filled completely with gas, which is done by placing the head so that the part under examination assumes a higher position than the rest of the ventricular system. It is consequently necessary to take a series of films in order to obtain a reliable demonstration of the ventricle under examination, and it is not possible to pass judgment on departure from normal before the whole series of films has been studied.

It is the routine at the Royal Victoria Hospital, Montreal, to have the patient lying on the roentgen table with the head upon the film and to take the following nine films: one anteroposterior with the brow up, one lateral with the brow up, stereoscopic roentgenograms with right and left side up, one posteroanterior with the occiput up, one lateral with the occiput up and

* Read at the American Congress of Radiology, Chicago, Ill., Sept. 25–30, 1933.

finally one more anteroposterior film with the forehead up.

In this way two anteroposterior roentgenograms are taken in the same position. This is done because the anteroposterior films, more than any others, give the most valuable information about the size, form and position of the ventricles. One of the anteroposterior roentgenograms is given a shorter development than the other in order to demonstrate especially the lighter shadows caused by the anterior horns. This will be discussed later.

Fig. 1. Model of the cerebral ventricles in a partial cast of a skull.

It has already been pointed out that the patient's head must be maneuvered so that the gas fills the parts of the ventricles which the film is meant to show.

For example, if one expects a pathological condition of the right inferior horn, the patient should be placed with the left side to the film, the head flexed somewhat towards the left shoulder and the face turned upward at an angle of 30°. In this position the right inferior horn will be situated at a higher level than the rest of the ventricular system. The optimal result when taking roentgenograms of the third ventricle is obtained by a lateral view when the patient lies on the back with the head bent backward as much as possible, while the fourth ventricle is best seen on a lateral film taken with the patient lying face down with the head bent forward.

The correct manipulation of the head as well as the interpretation of the films requires that the person who undertakes this work can visualize clearly the anatomical relationships of the ventricular system and to this end our model of the cerebral ventricles has been constructed (by A.T.) (Fig. 1), based upon injection casts of the cerebral ventricles and study of more than 450 selected sets of ventriculograms and encephalograms. The lateral view of the ventricles offers few difficulties of interpretation compared with the anteroposterior and the posteroanterior views and we will therefore consider primarily these latter views.

Figure 2 shows the lateral ventricle divided into six portions, each referring to a unit which can be recognized in the anteroposterior view of the ventriculogram. On the lateral ventricle (Fig. 2) and on subsequent sketches of ventriculograms these portions have been numbered 1 to 6.

Up to the present time the analyses of ventriculograms which have appeared in the literature have been personal opinions and based upon the author's ability (or inability) to interpret the ventriculogram and it is easy to point out many examples of obvious mistakes.

It would be an advantage if the descriptions of ventriculograms could be rendered objective, and a non-diagnostic and a non-interpretive terminology employed. This would make the discussion of ventriculographic findings more valuable because it would enable authors to express themselves in exact terms which would also make the appreciation of their communications easier for the readers.

Such terminology has been attempted here and we believe it would be an advantage if these terms (or better ones) could be generally adopted.

Shadow 1. The anterior horn passes laterally, forward and downward. In Figure 4

is seen a cross section of the brain through the anterior horn. The part which has been cut away is situated laterally and below the cavity seen on the illustration. Immediately above the brain is a sketch indicating the appearance of a ventriculogram if air filled the lumen only as far back as the terior to the anterior horn and in front of the thalamus. Figure 6 shows a section of the brain through this portion, and on the sketch immediately above is illustrated the appearance of the ventriculogram if air filled the lumen as far back as this level.

The anterior horn deviates from the

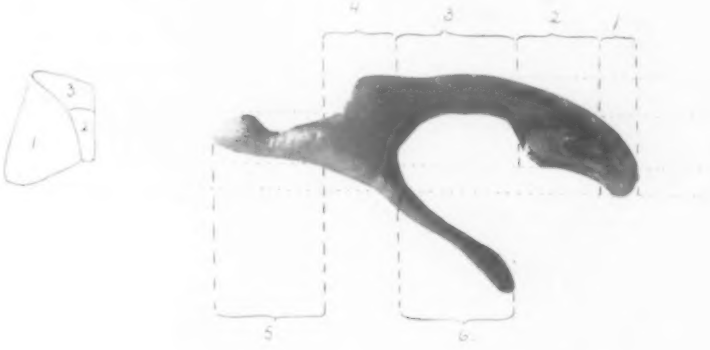


Fig. 2. Division of the lateral ventricle into six portions each referring to a unit which can be recognized in the anteroposterior ventriculogram. Portions 1, 2 and 3 are seen projected on an imaginary plate.

level of this section. One can see that the less air there is, the smaller the shadow and the farther laterally and downward it appears to be.

It is obvious that many observers are mistaken in assuming that the darker shadows 2 and 3 are caused by the anterior horn. This is, however, only a narrow space and its shadow consequently is faint. The mistake is rendered easier by the fact that the technician in the development allows shadow 1 to disappear in his effort to intensify shadows 2 and 3, which first attract his attention.

Shadow 2. This shadow is caused by the part of the ventricle which is situated pos-

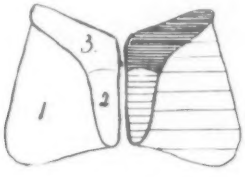


Fig. 3. Sketch illustrating the appearance of portions 1, 2 and 3 on the ventriculogram.

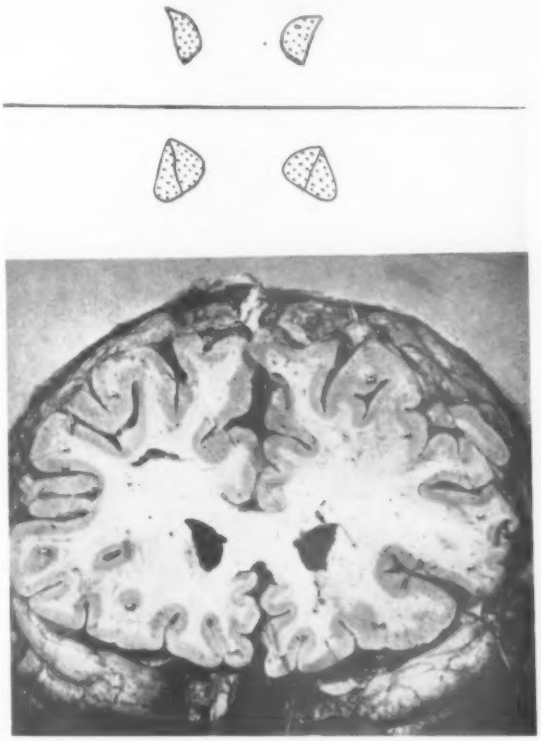


Fig. 4. Section of a brain through portion 1.

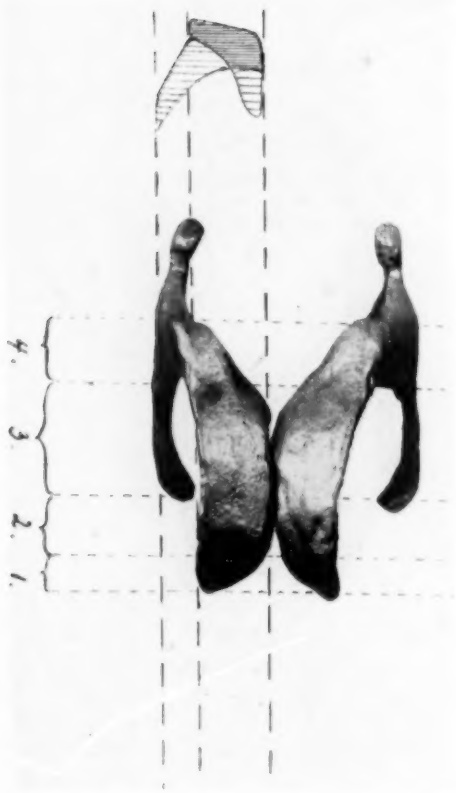


Fig. 5. Lateral ventricle seen from above. Note the lateral deviation of portions 1 and 4.

midline and its shadow on the ventriculogram will consequently be found too far laterally to be confused with shadow 2 (Fig. 2) and this is also true of portion 4 (Figs. 2 and 5).

Shadow 3. If air fills the ventricle farther back shadow 3 appears (Fig. 2). This is due to the total length of the upper part of the body of the ventricle and it is partly superimposed upon shadow 2 anteriorly and shadow 4 posteriorly.

If the head is tipped backward when the film is taken, shadow 3 is seen to merge into one outline with shadow 2 because the latter becomes situated at a higher level than the thalamus. Because of the length of this air-filled space it throws a darker shadow than any other part of the ventriculogram.

The importance of the position of the head is seen on Figure 7, *a*, *b*, *c*. This figure illustrates the projection of the ventricular shadows on the roentgen film. It is seen that shadow 2 merges with shadow 3 when the head is tipped backward, and that shadow 1 simultaneously becomes shorter. The variation of the distance between the orbit and the ventricular shadows should also be noted.

The sketch immediately above the brain in Figure 8 shows the familiar picture of a normal ventriculogram composed of shadows 1, 2 and 3, and the importance of the position of the thalamus becomes evident by the section of the brain in the same illustration.

If the entire ventricular lumen is filled with air, additional shadows 4, 5 and 6 can be seen as in Figure 9.

Shadow 4 (Figs. 2 and 9). This shadow is caused by the posterior part of the body of the lateral ventricle. This portion is situated posterior to the thalamus and is

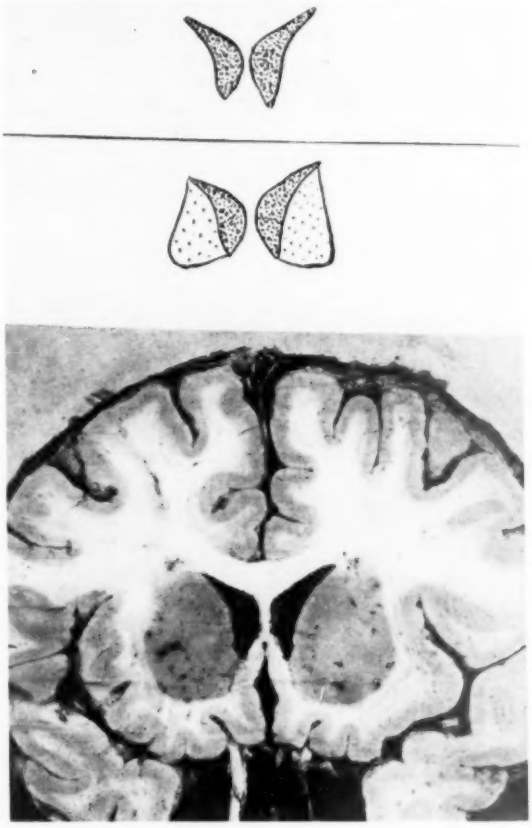


Fig. 6. Section of a brain through portion 2.

curved laterally and downward (Figs. 5, 9 and 10).

Portion 1 is situated closer to the roentgen tube than the posterior part, and its distorting magnification obscures to a certain extent the ventriculographic picture in making the anterior horn appear to extend from the midline for a distance equal to that of portion 4. The true relationships are seen in Figure 5.

Shadow 5. This shadow is caused by the posterior horn and cannot be seen constantly because bilateral and unilateral absence is found even in normal ventricles.[6] It usually appears as a dark circumscribed area between shadows 4 and 6, frequently projecting slightly medially (Figs. 10 and 11).

Shadow 6. This shadow is caused by the inferior horn of the lateral ventricle (Figs. 2 and 9). In the anteroposterior film it appears much shortened because its longitudinal axis is more or less parallel to the course of the rays. The borderline between shadows 4 and 6 is difficult to decide when the posterior horn (shadow 5) is absent.

Posteroanterior View. Characteristic of this view is that instead of the anterior now the posterior portion becomes more magnified (Figs. 11 and 12), but the same portions can be recognized as in the anteroposterior view, only the anterior horn and the temporal tip of the inferior horn can seldom be seen because of pooling of fluid in these lower portions.

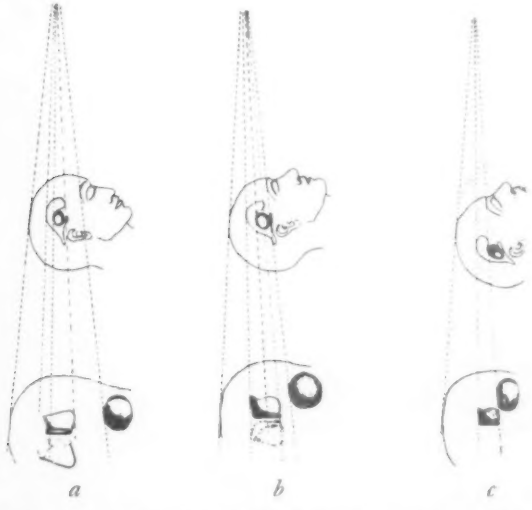


Fig. 7. Illustration of variations of the ventriculographic pictures depending upon the position of the head.

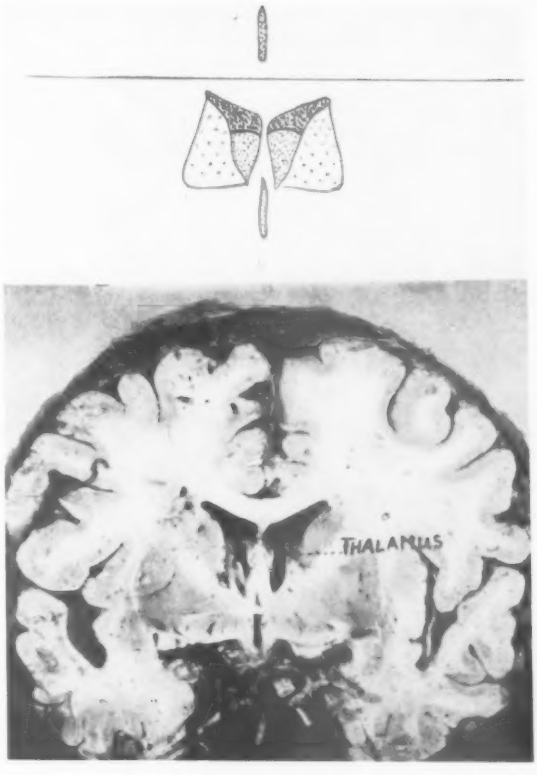


Fig. 8. Section of a brain through the posterior part of portion 2.

Lateral View. This view presents a few difficulties with regard to the interpretation. It should be observed that normally the upper outline of the lateral ventricle follows the outline of the skull so that the ventricle of a dolichocephalic patient is less curved than that of a brachycephalic individual.

The third ventricle is easily recognized by its form and position, and the aqueduct of Sylvius, leading down to the triangular-shaped fourth ventricle, runs almost vertically when the head is erect.

TUMORS OF THE TEMPORAL LOBE

The ventriculographic picture of cases of temporal lobe tumor will now be discussed, but before doing so, 3 typical cases

will be briefly described in which the diagnosis was verified at operation.

Case 1. (No. 83105. Royal Victoria Hospital, 1932.)

The patient was a male, aged, thirty-seven, who had a history of tuberculous peritonitis in 1913 and in 1930 an exploratory laparotomy was done because of localized edema in the lesser peritoneal sac.

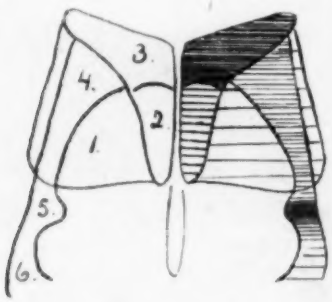
In 1931 he received a blow on the left forehead which caused momentary loss of consciousness.

In January, 1932, he sustained a fracture of the tibia and received also a slight head injury.

From this time he began to have headaches, gradually increasing in severity, and from August, 1932, he also began to have spells of vomiting and his eyesight became blurred.

He then sought medical advice and was admitted to the hospital because of bilateral papilledema.

The neurological symptoms were few and ventriculography was therefore carried out. On the ventriculogram (Fig. 13) it was found that the ventricles were enlarged, the right more so than the left. No air could be seen in the left descending horn (shadow 6). In the plates with the brow up, it was seen that both lateral ventricles had been pushed across the midline over to the right side. In this view it was found that the anterior horns (shadow 1) were approximately equal in size, but the body of the ventricle (shadows 2 and 3) was considerably narrower on the left side. This was less marked with regard to the vertical diameter which appeared only a little shorter than that of the right ventricle.



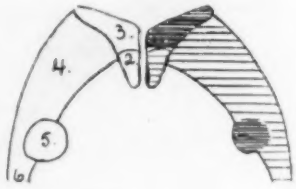


Fig. 9. (Upper left.) Sketch of a ventriculogram with the ventricles completely filled with air.

Fig. 10. (Lower left.) Illustration of the ventricular model seen in the anteroposterior view.

Fig. 11. (Upper right.) Sketch of a ventriculogram seen in the posteroanterior view.

Fig. 12. (Lower right.) Posteroanterior view of the ventricular model.

The upper part of the third ventricle was pushed over to the right but its lowest part was anchored to the midline at the base of the skull. It was not dilated but was slightly curved with the concavity towards the left side. The diagnosis of a tumor of the left temporal lobe was made and at operation a tumor of the left temporal lobe was removed.

Case II. (No. 86038. Royal Victoria Hospital, 1933.)

The patient was a male, aged fifty, whose past health had always been good. Five months previous to admission he suffered a slight head injury which, however, was followed by a most severe headache, which has lasted ever since. About four weeks previous to admission he fell down unconscious one day and since that time he has complained of double vision and loss of visual acuity. He was admitted to the hospital and ventriculography was carried out.

It was found (Fig. 14) that both lateral ventricles and the third ventricle were displaced to the right. The right lateral ventricle was symmetrically dilated. The left ventricle was also dilated but not to the same extent as the right. The anterior horn (shadow 1) and the two transverse measurements of the two ventricles were about equal, but the distance between floor and roof (of shadows 2 and 3) was much less on the left ventricle, and it could be seen that the roof and upper edge of shadow 3 were curved with the concavity upwards. In other words, it was shadow 3 which had been reduced in size.

Fig. 13. Case I. Ventriculogram. Anteroposterior view of a case with tumor of the temporal lobe.

Fig. 14. Case II. Ventriculogram. Anteroposterior view of a case with tumor of the temporal lobe.

The descending horn (shadow 6) of the left ventricle was shortened and pushed upward.

At operation a neoplasm in the left temporal region was removed.

Case III. (No. 85793. Royal Victoria Hospital, 1933.)

A woman, aged fifty-three, whose past health had always been good. About five months previous to admission, following an attack of grip, she began to have headaches with pain in the right side of the neck and occasional vomiting. She developed neurological symptoms which caused her admission to this hospital, where ventriculography was carried out.

The ventriculograms showed that both lateral ventricles and the third ventricle had been pushed over to the left side (Fig. 15). The left ventricle showed a general dilatation. The body of the right ventricle (shadows 2 and 3) was depressed but the transverse diameter of the anterior horn (shadow 1) was greater than normal as it had been elongated from right to left.

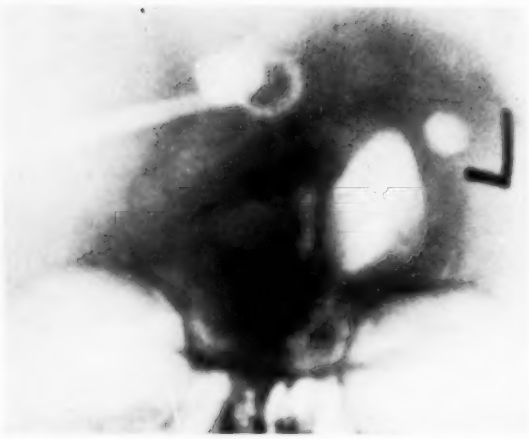


Fig. 15. Case III. Ventriculogram. Anteroposterior view of a case with tumor of the temporal lobe.

The descending horn (shadow 6) of the right ventricle was very small but contained air.

At operation a tumor in the right temporal region was removed.

DISCUSSION OF ' ENTRICULOGRAMS

The ventriculograms which have been presented here have several characteristics in common.

First of all, one can see clearly that the neoplasm has pushed both lateral ventricles across the midline to the opposite side. The degree of the displacement varies with the size of the tumor at the time when the ventriculogram is taken, but is generally considerable because of the size a neoplasm in this region ordinarily reaches before it causes symptoms serious enough to bring the patient to the hospital.

It can also be seen that the upper part of the third ventricle is displaced in proportion with the lateral ventricles, but the lower part remains anchored to the midline near the base of the skull by its connection with the immobile pituitary gland. The third ventricle thus assumes an oblique position, sometimes slightly curved, with the concavity toward the side of the tumor.

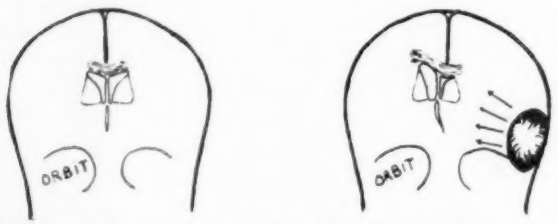


Fig. 16. Illustration of the mechanism of the typical ventriculographic changes in a case with tumor of the temporal lobe.

Following the partial obstruction of the outflow of cerebrospinal fluid, a varying degree of dilatation of the lateral ventricles and sometimes also of the third ventricle is commonly present. Such dilatation is most pronounced on the side opposite the tumor while the ventricle on the same side as the neoplasm is ordinarily somewhat compressed.

It is, however, typical for tumors in this location that the anterior horn (shadow 1) escapes the compression and remains more or less equal in size with the other anterior horn. This is especially well seen in Figure 13 where shadows 2 and 3 appear as a mere slit at the side of the tumor, at the same time shadow 1 is about equal on the two sides. The explanation is that the tumor exerting its pressure from the temporal lobe is situated so far back that the most anterior portion of the ventricle escapes disfiguration.

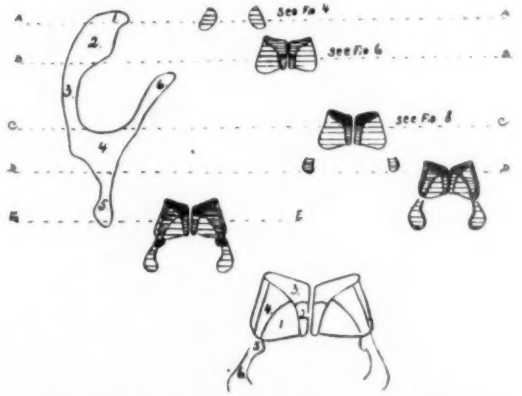


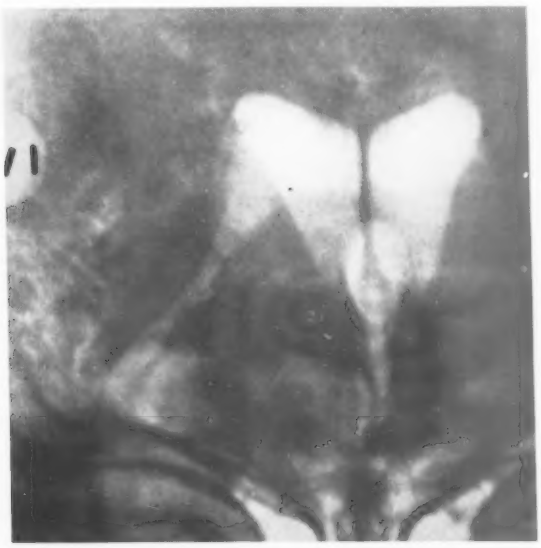
Fig. 17. The vertically placed ventricle represents the position in the anteroposterior film. The dotted lines through this ventricle represent different levels of fluid. The sketches of the ventriculograms on the lines illustrate the ventriculographic picture which appears when the part of the ventricle above the respective dotted line is filled with air.

It should perhaps be expected that a new growth in the temporal fossa would push the ventricle on the same side up-

ward rather than over to the other side. This is, however, not so. We do not see an elevation of the ipsolateral ventricle, at least not at the advanced stage when the ventriculograms are taken. On the contrary, we see that the ipsolateral ventricle is situated lower than the highest portion of the ventricle on the opposite side, and that the roof appears flattened and at times even excavated with the concavity up, while the heterolateral ventricle remains normally curved with the concavity down.

This is one of the most interesting and important changes for the recognition of temporal lobe tumors. The reason for this ventriculographic characteristic is as follows: During its growth the tumor pushes the brain mainly directly toward the opposite side but also somewhat upward (Fig. 16). The upper portion of the homolateral ventricle becomes slightly depressed by the rigid falx and the heterolateral ventricle slips up on the other side in a slightly higher position than normal. This is the mechanism of the very characteristic ventriculographic picture of a case with tumor of the temporal lobe.

Finally, it should also be pointed out that the descending horn (shadow 6) of the lateral ventricle on the side of the tumor generally at an early stage becomes compressed so it contains little or no air, and if seen it is frequently pushed upward and toward the opposite side.



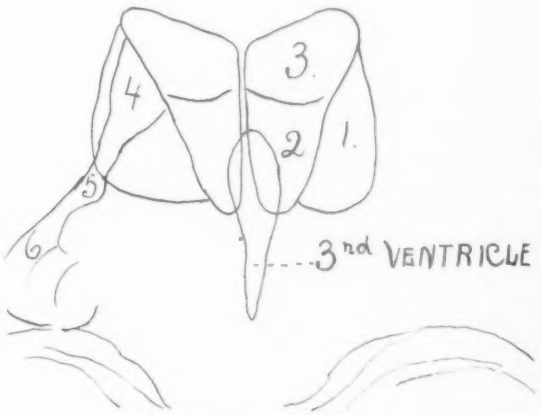


Fig. 18. Illustration of the appearance of the six shadows in a ventriculogram.

SUMMARY

A new model of the cerebral ventricles in a partial cast of a skull has been constructed and found to be of great use both for the technical procedure of ventriculography and the interpretation of the ventriculograms.

The lateral ventricle has been divided into six portions corresponding to units which can be recognized in the ventriculogram, anteroposterior view.

Three cases with verified tumor of the temporal lobe have been reported and the ventriculographic characteristics of tumor in this location pointed out.

REFERENCES

1. Antoni, N. On ventriculography. *Acta psychiat. et neurol.*, 1930, *5*, 249–268.
2. Dandy, W. E. Ventriculography. *Ann. Surg.*, 1918, *68*, 5.
3. Foerster, O. Encephalographische Erfahrungen. *Ztschr. f. d. ges. Neurol. u. Psychiat.*, 1924–1925, *94*, 512–584.
4. Grant, F. C. Ventriculography. *Arch. Neurol. & Psychiat.*, 1923, *10*, 154–166.
5. Liberson, F. The value and safety of a simplified method of pneumoencephalomyelography. Am. J. Roentgenol. & Rad. Therapy, 1926, *15*, 231–241.
6. Penfield, W. Cerebral pneumography, its dangers and uses. *Arch. Neurol. & Psychiat.*, 1925, *13*, 580–591.

FORM, SIZE AND POSITION OF THE MAXILLARY SINUS AT VARIOUS AGES STUDIED BY MEANS OF ROENTGENOGRAMS OF THE SKULL*

By H. JOBE SEDWICK, D.D.S.
ROCHESTER, NEW YORK

FOR many years the roentgenologist has routinely studied roentgenograms of the maxillary sinus as an aid in the diagnosis and treatment of disease of this structure. In the search for disease of the sinus, however, the roentgenologist does not have any correlation of size, shape, position, etc., with age and sex to help him in his diagnosis; nor do we find much in the literature concerning these factors. It is the purpose of this paper, therefore, to make a detailed study of the shape, size, position, variation, and measurements of the sinus in a representative group of roentgenograms of both sexes of various ages.

The maxillary sinus was first described by Dr. Nathaniel Highmore in 1651; hence it is often called today the antrum of Highmore. Since the maxillary sinus has been so thoroughly described by Schaeffer, he is freely quoted in this description. The sinus makes its appearance about the tenth week of fetal life, when the mucous membrane in the primitive middle meatus of the nose begins to pouch laterally. This pouch represents the anlage of the maxillary sinus, which pushes from the originally simple furrow separating the inferior and middle nasal concha.

The largest of the paranasal sinuses is the maxillary, which lies lateral to the nasal cavity and varies in shape, size and position. It follows, in the main, the shape of the body of the maxilla, and may be described as having three walls, a roof, and a floor. The walls vary in thickness: from a rather thick wall they are sometimes reduced to almost a tissue paper thinness. The median wall is directed toward the nose, the lateral wall extends into the root of the zygomatic process of the maxilla, and the ventral wall corresponds to the anterior or facial surface of the maxilla. Because of a very prominent canine fossa, part of this wall is at times very close to the dorsal wall and base of the sinus. The dorsal wall corresponds to the infratemporal surface of the maxilla and forms the ventral boundary of the infratemporal and pterygopalatine fossae. Although it is usually the thickest of the sinus walls, it is occasionally quite thin. The median wall, directed toward the nose, presents an irregular orifice, the formation of which is aided by the perpendicular part of the palate bone, the uncinate process of the ethmoid, the maxillary process of the inferior nasal concha, and a portion of the lacrymal bone. The opening formed by these bones is rounded over with mucous membrane, which is continued into the maxillary sinus from the nasal cavity. This opening affords a direct avenue of communication between the maxillary sinus and the nasal cavity. The medial wall, immediately inferior to the inferior nasal concha, is very thin and easily punctured. This wall, forming the lateral boundary of the nasal cavity, is often bulged into the cavity of the maxillary sinus, which greatly influences its size.

The roof of the sinus is a thin plate of bone and forms the floor of the orbit and the orbital surface of the maxilla. It is marked either by a ridge formed by the infra-orbital canal or by a groove which replaces this canal and which is covered over by the mucous membrane of the sinus. This canal or groove transmits the infra-orbital vessels and nerve.

The floor of the sinus is formed by the alveolar process of the maxilla, the thick-

* From the Departments of Anatomy and Medicine (Division of Radiology), School of Medicine and Dentistry, The University of Rochester, and The Strong Memorial Hospital, Rochester, N. Y. Presented at the meeting of the International Association for Dental Research, Chicago, Ill., March 17, 1934.

ness of the floor depending upon the degree of hollowing out of the process. In cases where the hollowing out has been carried far, the floor will bear an important relation to some of the teeth and their sockets and may contain many irregular elevations corresponding to the roots of the teeth. This relation depends upon the thickness of the layer of spongy bone, which varies in thickness in different skulls and on the two sides of the same skull. Bony septa, varying in height and thickness and dividing the floor into basins, frequently traverse the floor of the sinus. Since the maxillary sinus varies greatly in size in different skulls and in the two sides of the same skull, it is apparent that the relations of the teeth to the sinus cannot be constant.

In addition to the infra-orbital nerve and vessels already mentioned, the maxillary sinus is traversed by three canals transmitting nerves and vessels: first, by the posterior dental canals on the infratemporal wall of the dorsal surface and by the posterior alveolar nerve and vessels, which go to the molar and sometimes to the bicuspid teeth; second, by the middle dental canals on the lateral ventral surface and by the middle superior alveolar nerve and vessels, which go to the bicuspid teeth; third, by the anterior dental canals on the ventral medial surface and by the anterior superior alveolar nerve and vessels which go to the anterior and sometimes to the bicuspid teeth.

The roentgenograms for this study were selected from the files of the Strong Memorial Hospital and were taken over a period of years. No attempt at selection or segregation was made except as to age and sex. The patients were all of middle European or "American" stock living in northern New York State. These roentgenograms are routine "sinus roentgenograms" and are made according to the following standardized technique.

One roentgenogram is made by the true lateral projection with the median plane parallel to the plane of the film, the beam from the roentgen tube being centered through the sphenoid sinus region parallel to and just posterior to the outer canthus of both eyes. This roentgenogram is called the lateral. The other roentgenogram is made in the posteroanterior direction with the brow and nose touching the film holder and with the beam from the roentgen tube directed at the center of the film with the tube shifted 12° toward the vertex of the skull. This roentgenogram is called the posteroanterior. The target film distance is always 30 inches; a Potter-Bucky diaphram is used throughout.

For a comparative study, these roentgenograms were divided into age groups of ten-year intervals up to eighty years. Except in the last group, where not many roentgenograms were available, the sexes were fairly well divided. The lateral and posteroanterior roentgenograms were placed on a viewing box and covered with a thin transparent millimeter-graph paper, upon which was traced the outline of the maxillary sinus, nasal cavities, and palate, when traceable. The vertical height, transverse width, and the anteroposterior length were all drawn in. By means of a millimeter rule the measurements of the sinus as shown on the tracing were made, and the greatest anteroposterior length, transverse width, and vertical height were recorded. Observations as to the location of the sinus in relation to the sides and floor of the nasal cavity were also made and recorded. The sinuses were classified into groups according to general shape (see Fig. 1). Cases in which the sinuses differed in either side were classed as irregular. The classification figures given are based upon the measurements of both sinuses in the patient and not upon the individual sinus on one side. The cases resolved themselves into five classes which in order of numbers are as follows: triangular, 80; oval, 42; irregular, 33; and oblong and square, each 9.

In the first age group (three to ten) the oval and oblong shaped sinuses seem to be about equally divided, each making about one-third of the total group. The other third is divided

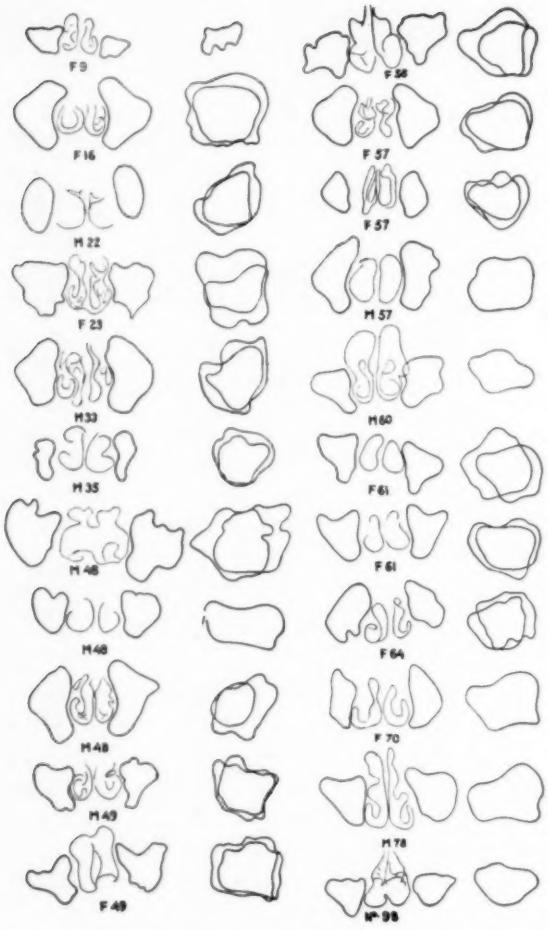


FIG. 1. These tracings indicate or represent the common variations in the size, shape and position of of the sinuses in the age groups studied. *F* = female. *M* = male. Numeral = age, except in the one having a number only (pre-Columbian Indian skull).

equally between the triangular and irregular shaped sinuses.

In relation to the floor of the nose, about two-thirds of the entire group are close to the floor; of the remainder the majority are below the floor of the nose while only two are above the floor. In relation to the sides of the nose, about two-thirds are also close while about one-third are distant (wide). In two-thirds of the whole group, therefore, the sinuses are close to the nasal cavity, both as to floor and sides, while in the other third the sinuses are distant from the nasal cavity, both as to floor and sides.

The average age of this group is about five years. The average measurements for the group are: vertical height 22 mm. both right and left, transverse width 19 mm. both right and left, and 27 mm. for anteroposterior length. There is very little difference between the average measurements of both sexes. The average vertical height both right and left for the males is 23 mm., and for the females 22 mm.; the average transverse width for the males is 17 mm. right and 18 mm. left, and for females it is 20 mm. both right and left. The average anteroposterior width is the same for both, 27 mm. The maximum vertical height for the group is 28 mm. both right and left, while the minimum is 16 mm. right and 15 mm. left. The maximum transverse width is 29 mm. on the right and 25 mm. on the left, while the minimum is 12 mm. on the right and 13 mm. on the left. The maximum anteroposterior length is 38 mm. and the minimum is 20 mm.

In the second age group (ten to twenty) the oval and triangular shapes seem to be about equally divided, the two together making up about three-fourths of the group, while the square, irregular, and oblong shapes respectively make up the remainder of the group. In relation to the nasal cavity, the majority are close both to floor and to sides. The rest are about equally divided, some being distant from the sides, and some being above and some below the floor. The average age of the group centers around fourteen. The average measurements are: vertical height right 33 mm., left 34 mm.; transverse width right 27 mm., left 26 mm.; and anteroposterior length 39 mm. There is some difference between the average measurements of the males and females in the vertical height but the average of the other measurements is about the same. The average vertical height for the males is right, 37 mm. and females 30 mm.; for the left, males 36 mm. and females 32 mm. The transverse width both right and left, male and female, is the same, 27 mm. right and 26 mm. left. The average anteroposterior length for males is 40 mm. and for females 38 mm. The maximum vertical height is the same for both sides, 52 mm., while the minimum vertical height on the right is 15 mm. and on the left 21 mm. The maximum and minimum transverse width is the same on both sides, respectively 36 and 18 mm. The maximum anteroposterior length is 55 mm., while the minimum is 27 mm.

In the third age group (twenty to thirty), almost all shapes are represented, the irregulars leading and making almost half the group.

The sum of the triangular and oval types equals the number of irregular types while the square and oblong shapes make up the remaining few. In relation to the floor of the nose, the majority are low and only two are high. In relation to the sides of the nasal cavity, the great majority are close. There is little difference between males and females. The average age of this group is twenty-four years. The average vertical height is 39 mm. on the right and 40 mm. on the left. The average transverse width is 27 mm. on the right and 27 mm. on the left, and the average anteroposterior length is 45 mm. The average vertical height for males on the right is 39 mm. and for females it is 39 mm., while on the left the average for the males is 42 mm. and for the females 38 mm. The average transverse width for males is slightly greater. The male average on the right is 28 mm. while the female average is 26 mm. On the left the male average is 27 mm. and the female 27 mm. The average anteroposterior length for the males is 46 mm., and for the females 43 mm. The maximum vertical height on the right is 55 mm. while the minimum is 32 mm. On the left the maximum is 53 mm. and the minimum 30 mm. The maximum transverse width on the right is 40 mm., and on the left it is 39 mm. The minimum transverse width both right and left is also the same, 20 mm. The maximum anteroposterior length is 55 mm. and the minimum 30 mm.

In the fourth age group (thirty to forty), a little over half the group is triangular in shape. The great majority of the rest are oval, there being just one oblong and one square. In the majority of cases the sinuses are below the floor of the nose and close to its sides. Of the remaining cases an equal number are the reverse, i.e., close to the floor of the nose and distant from its sides. Only 6 cases are above the floor of the nasal cavity. The average vertical height for the group is 36 mm. right and 37 mm. left. In this measurement there is a noticeable difference between males and females. The average of the males on the right is 39 mm. and the females 33 mm. On the left the average of the males is 41 mm. and of the females 34 mm. The average of the transverse width for the group and for both males and females on the right is the same, 25 mm. On the left it varies slightly. The group average is 24 mm., the male average is 23 mm., and the female slightly more, or 26 mm. There is about the same difference in the averages of the anteroposterior length. The group average is 41 mm., the male 42 mm., and the female 40 mm. The maximum anteroposterior length is 58 mm., and the minimum is 27 mm. The maximum transverse width on the right is 39 mm. and the minimum 13 mm. On the left the maximum is 35 mm. and the minimum 14 mm. The maximum vertical height on the right is 62 mm. and the minimum 21 mm. On the left the maximum is 54 mm. and the minimum is 21 mm. The average age of the group is thirty-four.

In the fifth age group (forty to fifty), the majority of the sinuses are also triangular in shape, and of the remaining, 6 are oval and one irregular. In relation to the floor of the nose they are about equally divided between low and close, only one being above the floor, while in relation to the sides of the nose all but two cases are close. The average vertical height for both the males and females on the right is 36 mm. On the left it is 38 mm. The average transverse width on the right for both the males and the females is the same, 28 mm., while the left the average for the males is 26 mm. and for the females 27 mm. The average anteroposterior length for the males is 44 mm. and for the females 43 mm. The average for the group is vertical height, right 36 mm., left 38 mm.; transverse width, right 28 mm., left 26 mm.; and the anteroposterior length 43 mm. The maximum vertical height on the right is 49 mm., and on the left 50 mm., while the minimum on the right is 21 mm. and on the left 24 mm. The maximum transverse width on the right is 41 mm. and the left 39 mm., and the minimum right is 22 mm. and the left 20 mm. The maximum anteroposterior length is 52 mm. and the minimum 37 mm. The average age of the group is forty-five.

In the sixth age group (fifty to sixty), one-half of the sinuses are triangular in shape and the other half are about equally divided between the irregular and the oval shapes. In the relation to the nasal cavity, the majority are below the floor and close to the sides. The rest are close to the floor and distant from the sides, none being above the floor. The group average of both sides for the vertical height is the same, 37 mm. For the transverse width the average on the right is 26 mm. and on the left 25 mm. The average anteroposterior length is 41 mm. These averages for the males are slightly higher than for the females. The average vertical height for males is 38 mm. on the right while for females it is 36 mm. On the left for males it

is 38 mm. and for females 37 mm. The average transverse width for males on the right is 28 mm. and for females 24 mm., while on the left for males it is 25 mm. and for females 24 mm. The average anteroposterior length for the males is 42 mm. and for the females 40 mm. The maximum vertical height on the right is 47 mm. and on the left 48 mm. The minimum for the right is 27 mm. and for the left 25 mm. The maximum transverse width on the right is 33 mm. and on the left 35 mm., while the minimum on the right is 18 mm. and on the left 17 mm. The maximum anterior length is 56 mm. and the minimum is 30 mm. The average age of the group is fifty-four.

In the seventh age group (sixty to seventy) 15 are triangular and 6 irregular. In relation to the floor and sides of the nasal cavity, the majority are close. Some, however, are below the floor and distant from the sides of the nose. Four are above the floor of the nasal cavity. The average group measurements for the vertical height on the right is 35 mm., and on the left 36 mm., and for the transverse width right and left it is 27 mm. and 26 mm. respectively. The average anteroposterior length is 44 mm. The average measurements for the females are in most cases slightly greater than for the males. The average vertical height for both sexes on the right is the same, 35 mm.; on the left the males are 35 mm. and the females 36 mm. The average transverse width on the right for males is 26 mm. and for females 27 mm., while on the left it is 25 for males and 27 mm. for females. The average anteroposterior length for males is 43 mm. and for the females 45 mm. The maximum vertical height is different on each side, the right being 50 mm. and the left being 45 mm. The minimum is about the same, on each side, 18 mm. on the right and 19 mm. on the left. The maximum transverse width is also about the same on either side, on the right 35 mm. and on the left 37 mm. The minimum is the same on both sides, 20 mm. The maximum anteroposterior length is 56 mm. and the minimum is 35 mm. The average age of the group is sixty-six.

In the eighth age group (seventy to eighty), in which only 5 cases were available 4 are triangular and one irregular. In relation to the nasal cavity, the majority are close both to floor and sides, 2 are below the floor and distant from the sides, and one is above the floor of the nose. The group average for the vertical height is 37 mm. on the right and 38 mm. on the left. For the transverse width the average on the right is 24 mm. and on the left 26 mm. The average anteroposterior length is 42 mm. Since there is only one female, no comparative averages will be given. The maximum vertical height on the right is 45 mm. and on the left 44 mm. The minimum is 30 mm. on the right and 34 mm. on the left. The maximum transverse width is 30 mm. on the right and 33 mm. on the left, while the minimum is 16 mm. on the right and 20 on the left. The maximum anteroposterior length is 50 mm. and the minimum 35 mm. The average age of the group is seventy-five.

In the last group of 9 pre-Columbian Indian skulls, for which we are indebted to Mr. William Ritchie of the Rochester Museum of Arts and Science, 4 are triangular, 2 are oval, 2 square, and one irregular. In relation to the nasal cavity, the majority are close to both floor and sides; an equal number, however, are below the floor and distant from the sides of the nasal cavity. The group average for the vertical height on the right is 27 mm. and on the left 28 mm. The average transverse width on the right is 26 mm. and on the left 25 mm. The average anteroposterior length is 37 mm. The maximum vertical height on the right is 39 mm. and on the left 42 mm., while the minimum is 14 mm. on the right and 19 mm. on the left. The maximum transverse width is the same on either side, 36 mm., while the minimum is 13 mm. on the right and 15 mm. on the left. The maximum anteroposterior length is 45 mm. and the minimum 23 mm.

In the anatomical texts such as Cunningham, Gray, Morris and Callander, the maxillary sinus is referred to as a pyramidal-shaped cavity. This statement agrees with the findings of this study in about half the cases, but in approximately half the number the shape is found to be other than pyramidal or triangular. Reference texts also describe the base of this triangle as being placed medially while this investigation finds many in which the base is directed upward, some in which it is directed medially, and a very few in which it is directed downward. Morris, Cunningham, and Gray say that the sinus varies in size and shape, with which statement the findings of this study wholly agree. Cunningham says that the floor of the sinus is be-

low the level of the floor of the nose, Callander says most maxillary sinuses have their floor below the floor of the nasal fossa, and Gray says that in sinuses of average size the floor of the sinus is on a level with the floor of the nose, and that if the sinus is large its floor reaches below the floor of the nose. Schaeffer says that the majority of sinuses have their floors at varying distances inferior to the floor of the nose, giving as follows the figures for 60 cases examined: 39 inferior to nose, 12 above the nasal floor, and 9 on the same level. Schaeffer says also that the relation of the floor of the maxillary sinus to the floor of the nose depends largely upon the degree of hollowing out of the alveolar process of the maxilla. When the layer of spongy bone is thin, i.e., the alveolar process of the maxilla markedly hollowed out, the floor of the sinus is at a lower level than the floor of the nose. On the other hand, when the alveolar process is comparatively thick, the floor of the nose is at a lower level than the floor of the sinus. Resschreiter, quoted by Schaeffer, says that it is a male characteristic to find the sinus floor at an inferior level to the nasal floor, but Schaeffer states that he has been unable to verify the statement, giving figures for 12 female specimens examined as 9 below nose, 2 above, and one on the same level. In this study the relation of the sinus to the floor of the nose was found to be as follows: below the nasal floor, males 77, females 68; close to or on the same level, males 73, females 79; and above the nasal floor 16 males and 14 females. Of the total sinuses studied, 151 are below the floor of the nose, 163 close to the floor or about on a level with the floor, and 30 above the level of the floor. In relation to the sides of the nose 269 are close, the other 75 being at varying distances. Gray gives the measurements for an average sized sinus as height, 37.5 mm.; width, 25 mm.; and anteroposterior length 30 mm., which closely coincides with Cunningham's measurements, namely, height, 35 mm.; width, 25 mm.; and anteroposterior length, 30 mm. Both of these also closely coincide with Schaeffer's measurements of 90 adult sinuses giving the height as 33 mm.; the width as 23 mm.; and the anteroposterior length as 34 mm. The average measurements made in this investigation include, of course, nearly all ages and are as follows: height, 34 mm.; width 25 mm.; and anteroposterior length, 39 mm. All the measurements seem to closely coincide, except the measurement of the anteroposterior length, which, in this study, is a little more than that given by the other investigators. The average maximum vertical height is 46 mm.; while the minimum is 22 mm. The average maximum transverse width is 35 mm. and the minimum 17 mm. The average maximum anteroposterior length is 51 mm. and the minimum 29 mm.

The average height of the sinus for males and females is 35 mm. and 34 mm. respectively; the average width for males and females is 25 mm. and 24 mm. respectively; and the average length 40 mm. and 40 mm. respectively. Schaeffer says that although the sinuses of the male average slightly larger than those of the female, sex affects the size of the sinus but slightly, with which the findings of this paper closely agree. The average of the first age group (three to ten) is, of course (since growth is in progress), decidedly less than the average of all ages or of the second age group (ten to twenty). In the second age group the average height is less than that of the third age group (twenty to thirty), the remaining measurements being about the same. In the third age group the average measurements are greater than the fourth age group (thirty to forty). In the fourth age group the average measurements are less than the third and the fifth age group (forty to fifty). In the fifth age group the average measurements are greater than the sixth age group (fifty to sixty) and less than the third age group (twenty to thirty). In the sixth age group the height is greater than the seventh age group (sixty to seventy) and the length is less. In the seventh age group the reverse is true: the

height is lower and the length is greater than in the seventy to eighty group. Schaeffer says that in the adult, age does not have much bearing upon the size of the sinus. In these studies, although slight differences are found, they are not very marked. It is apparent, however, that as the groups increase in years the proportion of triangular-shaped sinuses also increases. In the pre-Columbian Indian group the measurements, except for the height, are about the same as the others. The height is less than any other group except of course the first age group (three to ten).

SUMMARY AND CONCLUSIONS

1. The maxillary sinus varies greatly in shape, size and position, not only in different individuals but in each side of the same individual.

2. The sinus reaches its maximum size during the third decade of life and does not increase thereafter.

3. In later decades there is a definite tendency towards the assumption of triangular form.

4. When the sinus is triangular in form, the position of its base varies.

5. The relation between the floor of the sinus and that of the nasal cavity varies and is not a characteristic of sex.

6. The sinus is in close proximity to the sides of the nasal cavity.

7. The only difference between the sinuses in the white and Indian skulls examined is that the vertical height is less in the Indians, a fact which might be correlated with the shorter nose and broader cheeks of this race.

8. The average measurements for the sinus, based upon 173 cases or 346 sinuses, are as follows: height, 34 mm.; width, 25 mm.; and anteroposterior length, 39 mm. The average maximum and minimum measurements are: height, maximum, 46 mm.; minimum, 22 mm.; width, maximum, 35 mm., minimum, 17 mm.; anteroposterior length, maximum, 51 mm., and minimum, 29 mm. The average height for males is 35 mm. and for females 34 mm. The average width for males is 25 mm. and for females 24 mm. The average length for both males and females is 40 mm.

I wish to acknowledge the assistance of Dr. Stafford L. Warren, Head of the Division of Radiology, School of Medicine and Dentistry and Strong Memorial Hospital, in furnishing the roentgenograms for this study and I wish also to thank him for his good advice and counsel during the progress of the work. I wish also to thank Dr. Alton Brashear, Fellow in Dentistry, working in the Department of Anatomy, for so kindly checking all the figures and measurements in the tables and charts incident to this study.

REFERENCES

1. Callander. Surgical Anatomy. W. B. Saunders, Philadelphia, 1930.
2. Cryer, M. H. *Dental Cosmos*, 1896, *38*, 1.
3. Cunningham. Human Anatomy. Sixth Edition. William Wood and Co., New York.
4. Gray, Lewis. Human Anatomy. Twenty-first edition. Lea and Febiger, Philadelphia.
5. Kerley, C. G., and Lorenze, E. J., Jr. X-ray and clinical study of accessory sinuses in 430 infants and children. *J. Pediat.*, 1933, *2*, 175–186.
6. Morris. Human Anatomy. Second edition. P. Blakiston's Son and Co., Philadelphia.
7. Morris. Human Anatomy. Fifth edition. P. Blakiston's Son and Co., Philadelphia.
8. Noyes, T. B. *Tr. Am. Laryngol., Rhinol. & Otol. Soc.*, 1912, *18*, 273–300.
9. Schaeffer, J. P. *Am. J. Anat.*, 1910, *10*, 313.

Vol. XXXII, No. 2

CHRONIC INTERMITTENT DUODENAL STASIS*

By JULIUS FRIEDENWALD, M.D., *and* MAURICE FELDMAN, M.D.
BALTIMORE, MARYLAND

A CONSIDERABLE number of publications have appeared in recent years pointing to the importance and frequency of chronic duodenal stasis, an affection which is now recognized by most authorities as a definite clinical entity. The intermittent type to which we desire to call special attention in this paper has not, however, been so clearly defined. In previous publications,[1,2,3] we pointed out the necessity of repeated roentgen studies in order to establish the diagnosis of the chronic form of this condition. The same method of investigation is likewise of greatest value in arriving at the diagnosis of the intermittent type.

ETIOLOGY

We have already pointed out that, from an etiological standpoint, the mesentery causes only a moderate pressure upon the duodenum when its length is sufficient not to occasion an unusual dragging on the superior mesenteric artery. However, when it remains short due to lack of embryological development and when it is burdened with the entire weight of the small intestine, the artery is put upon a stretch and as a result compression of the duodenum to a greater or lesser degree follows. Five main factors are involved in the production of intermittent duodenal stasis: (1) Arterio-mesenteric compression of the duodenum associated with visceroptosis. (2) Movable tumors or masses producing pressure and similarly from spinal deformities; also movable growths involving abdominal organs as from the pancreas or pressure from a ptosed right kidney or enlarged calcified retroperitoneal glands. (3) Adhesions and congenital bands, or lesions elsewhere in the digestive tract producing reflex disturbances of motility in the duodenum. (4) Stretching and sagging of the duodenum due to overloading. (5) Dysfunction of the neuromuscular mechanism of the duodenum in some instances.

INCIDENCE

In a study of 50 typical cases of chronic intermittent duodenal stasis, it was noted that this condition may occur at any age, though the greatest incidence is during middle life. In our cases, the ages ranged from twenty to sixty-seven years. It was noted much more frequently in females than males. The incidence of this condition is much greater than may be inferred from the literature. There is probably a large group of cases which is not recognized because of insufficient roentgen study.

In the following table our cases are arranged according to age and sex.

Years	Males	Females
20–30	1	7
30–40	2	6
40–50	10	12
50–60	4	2
60–70	5	1
Total	22	28

SYMPTOMATOLOGY

The symptoms of chronic intermittent duodenal stasis are by no means always characteristic, especially in the milder forms. Frequently, however, periodic bilious attacks occur, associated with nausea and vomiting, which may extend intermittently over a period of many years, often dating back to childhood and not uncommonly with long intervals of good health alternating with periods of discomfort. There is but little question that prolonged nervous strain has a tendency to induce the attacks. These so-called bilious attacks are frequently preceded by intense constipation and are often associated with head-

* From the Gastro-Enterological Clinic of the Department of Medicine, University of Maryland, Baltimore.

aches and migraine attacks. Intermittent outbreaks of diarrhea not uncommonly alternate with periods of constipation. In 12 of our cases attacks of nausea and vomiting occurred; in 31 migrainous headaches, and in 6 intermittent forms of diarrhea were noted. Pain, which ordinarily presents no special relation to food, may be severe or mild; it was present in 29 of our cases, of which 17 were severe and 12 mild. It is an interesting fact that change in posture may at times afford relief from this symptom.

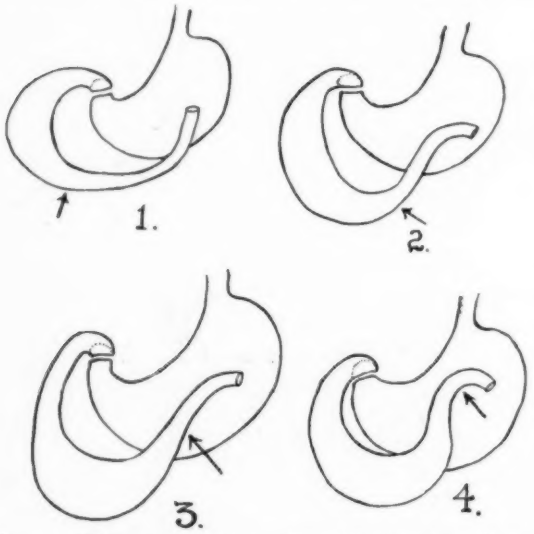


FIG. 1. Diagrammatic drawing, illustrating dilated sections of the duodenum. The arrows point to the narrowed segment, where the barium meal seems to be temporarily retained.

Loss of weight and strength associated with extreme exhaustion is not uncommonly observed as a result of the frequent recurrence of these attacks, and mental depression as well as neurasthenic symptoms often supervene. However, during the interval of freedom from these attacks, the patient may enjoy comparatively good health extending over periods of months or even years. In the milder types in which the attacks occur infrequently, the pylorus retains its normal tonicity and regurgitation takes place only when an excessive amount of duodenal contents accumulates. During an attack the patient ordinarily complains of epigastric distress, fullness and distention, of eructations of gas and not infrequently of epigastric pain. Occasionally, however, the pain may extend to the region of the gallbladder and may be accompanied by an enlargement of the liver.

CASE REPORT

The following history presents the most important features of a typical case:

M. H., female, aged sixty-one, had been complaining of indigestion for about thirteen years. It consisted of transient attacks of intense nausea associated with severe pain in the right upper quadrant of the abdomen, radiating toward the right shoulder and lumbar regions. Vomiting occasionally occurred and heartburn, acid eructations, fullness and distention were prominent symptoms during this period. During the attacks the patient was extremely constipated. The attacks would extend over a period of five to six days and were frequently associated with sick headaches and occasionally with migraine attacks. The vomitus occasionally contained food ingested on the previous day. Recently the attacks have become more frequent, occurring at intervals of two to three weeks and were of such intensity as to require confinement to bed. She had lost 20 pounds in weight during the past six weeks. During the symptomless intervals the patient ordinarily regained her health fully, was able to eat liberally and apparently had a normal digestion.

On examination the chest organs were found to be normal. The abdomen was soft and extremely relaxed, and no enlargements, masses or peristaltic waves were present, but there was a distinct area of tenderness under the right costal arch and in the region of the right kidney. The latter was easily palpable. The gastric contents obtained after a test meal showed a total acidity of 16 with an absence of free hydrochloric acid but contained considerable mucus. This finding was observed upon a number of examinations. A meal given at night and extracted the following morning disclosed considerable retention. However, this only occurred during and immediately following the attack. Gastric retention was never noted between the attacks. The roentgen examination made immediately following an attack gave the following findings: "The stomach is markedly prolapsed. No filling defects are present. The pylorus and duodenal cap are normal; the second portion of the duodenum is moderately

dilated and shows distinct stasis extending over a period of many hours. The colon is prolapsed upon the floor of the pelvis." When the patient was reëxamined, between attacks, all evidence of duodenal retention had disappeared.

DIAGNOSIS

The patient is usually slender, of the asthenic visceroptotic type. The gastro-intestinal tract is frequently prolapsed and at times atonic and a succussion sound can ordinarily be elicited over the gastric area. A tender epigastric area is usually noted during or soon following upon an attack; occasionally, however, the tenderness is found to the right or left of the umbilicus. At times there is general abdominal distention and the duodenal dilatation may be so marked as to present the sensation of a tumorous mass on palpation. This area may be tympanitic or a succussion sound may be elicited and pressure over it may produce nausea. As an aid in diagnosis the sign described by Hayes[4] may be of value. It consists of producing pressure over the abdomen below the umbilicus, the abdominal wall and intestines are forced upward, back and to the left. By maintaining this pressure for a short time, opening of the duodenojejunal angle occurs, the mesentery is raised and the duodenum empties its contents into the jejunum with an entire disappearance of the tympanites.

Ordinarily the gastric acidity is normal in the milder types; occasionally, however, hypo- or hyper-acidity may occur. During prolonged attacks, achylia may occur temporarily due to the admixture of bile in large amounts. The gastric acidity was normal in 29 of our 50 cases, hyperchlorhydria was present in 14 instances and hypochlorhydria and achylia in 7.

The diagnosis of duodenal stasis may be suspected when in an asthenic visceroptotic individual the symptoms above described are observed. While the diagnosis is occasionally possible from the history and physical findings alone, the roentgenological evidence is far more conclusive. The roentgen signs of this condition are well defined and extremely characteristic and a positive diagnosis can be made only by the use of this procedure.

The roentgen findings are based largely upon the roentgenoscopic examination by means of which changes in motility can be carefully observed. It must be emphasized, however, that the roentgenological picture often changes, depending upon the stage at which the examination is made. If it happens to be made during a quiescent period, changes in the duodenum may be so slight as not to be detected. On the other

Fig. 2. Roentgenogram of a moderately dilated transverse portion of the duodenum at *A*. Point of temporary constriction at *B*.

hand, if the examination is undertaken during the height of one of the periodic spells, the roentgen changes in the duodenum are diagnostic. This variation is due to the intermittent character of the condition for the stasis may be present at one examination and not at another. Though the changes are best demonstrated under the roentgenoscope, they may likewise usually be recorded on the films. Since most films of the digestive tract are ordinarily taken in the recumbent posture, the duodenum may at times be overshadowed or, due to the favorable position, may be emptied so rapidly that the characteristic picture may not be obtainable. Delay in the passage of barium is not infrequently overcome by

change in posture as can readily be observed under the screen.

The roentgenoscopic examination is usually most satisfactorily made with the patient in the upright posture. The duodenum is viewed from all angles; the semilateral, however, was found to present the best exposure for the visualization of the entire duodenum. The entire duodenum may thus be brought into view and the stomach displaced by the palpating hand which eliminates it from the dependent portion of the

Fig. 3. A puddling of barium noted at *B*, where the contrast meal seems to be retained in the ascending segment of the duodenum. The transverse portion also shows some retained barium. The duodenal cap is slightly enlarged.

duodenum. In doubtful instances, the distal duodenum may be compressed against the spine, which will produce or aggravate the stasis. It may also produce a clearer view of the entire duodenum.

The greatest difficulty in the diagnosis of this affection occurs in those types in which the changes are slight. In these, the delay of the contrast meal is usually so moderate as to vary little from the normal.

Normally, the entire duodenum is not ordinarily completely visualized. It is regular in configuration and feathery in appearance. When the entire lumen is well visualized throughout, it usually indicates an abnormal state and suggests the presence of stasis. The lumen may, however, occasionally become well filled under normal conditions, due to rapid emptying of the stomach and the greatest care must therefore be exercised in interpreting this finding. In the more marked cases of duodenal stasis, however, gastric as well as duodenal residues of six hours or more are not uncommon.

The lumen of the duodenum may present varying degrees of dilatation during an attack, while in the interval the duodenum may assume its normal caliber. The dilated duodenum can frequently be more satisfactorily observed between one-half to two hours following the barium meal. In order to eliminate the presence of duodenal stasis, the duodenum must be observed at intervals over a period of at least thirty to forty minutes. The presence of this condition is suggested when the duodenum is constantly visible during the period of emptying of the stomach.

Regurgitation of the contrast meal from the distal portion of the duodenum back into the bulb may at times occur normally, but exaggeration of this sign is an indication of duodenal disturbance.

In stasis occurring in the upper segment of the duodenum the bulb may become elongated and greatly dilated and present a delay in the expulsion of barium. On close observation of the contrast meal a distinct delay in its passage will be noted at a certain point where it remains stationary as if there were a permanent obstruction. In the more advanced forms, after a few violent peristaltic movements (the so-called writhing duodenum) some of the barium is transported through the area of transient stenosis and another portion of the barium is forced back into the bulb. These phases are rapidly repeated, and after a certain delay, the barium passes into the jejunum. The duodenum above the area of apparent obstruction is dilated to a greater or less degree.

Stasis occurred in most of our cases in the second portion of the duodenum between the transverse and ascending segments.

The only absolute proof, therefore, of

intermittent duodenal stasis is the demonstration of a definite prolongation of the emptying of the duodenum, the contrast meal being delayed as if by a definite obstacle. Periodic changes in the roentgen picture depending upon the stage of the attack is an important factor in diagnosis which cannot be too greatly emphasized. Dilatation of the lumen is likewise commonly present in this affection.

Finally, in considering the diagnosis, the fact should be stressed that chronic intermittent duodenal stasis is not uncommon and that it is frequently overlooked. This difficulty arises from the fact that in some instances the affection may continue for long periods without presenting symptoms and in the interval between attacks even the roentgen signs may be absent. It is of the greatest importance in order to be certain of the presence of the condition that repeated roentgen studies be carried out and especially during or immediately following an attack.

Repeated examinations were made in all cases in our series. Inasmuch as headaches associated with nausea and vomiting are frequently present, the diagnosis of migraine is not uncommonly made. On this account, it is of the greatest importance in obscure types of migraine that complete roentgenologic studies of the duodenum be undertaken. In some instances the symptoms have been attributed to cholecystic disease, appendicitis, ulcer or even neurasthenia.

Inasmuch as the clinical history of this affection is indefinite, certain characteristics should be borne in mind. Occasionally single attacks occur following meals lasting but a few days, then disappearing for a shorter or longer period of time and then recurring. At times the attacks occur daily following meals. It is likewise important to note that the attacks may occur in childhood and the condition itself remain unrecognized until later in life when the symptoms become sufficiently distressing to demand thorough investigation. In many instances, the attacks appear suddenly following relaxation of the abdominal organs or after serious debilitating diseases or pregnancy.

Fig. 4. An oblique view is shown, demonstrating a duodenal stasis in the descending segment of the duodenum at *A*. Point of constriction at *B*. In the anteroposterior position this condition was entirely obscured. This illustrates the value of a film in the oblique view in studying intermittent stasis.

TREATMENT

In a large proportion of the cases, medical measures are quite satisfactory and with conservative treatment, especially of the postural type, satisfactory results are usually obtained; the cases due to visceroptosis are especially amenable to this plan of treatment.

In severe types, complete rest in bed for a period of from four to six weeks is indicated in order to accomplish the best results. Inasmuch as many of these patients are of the visceroptotic type, the usual treatment employed for this condition is indicated. Postural treatment is of considerable advantage and gradually increasing exercise is allowed in order to strengthen the abdominal walls. The knee-chest posture practiced several times daily for a period of ten minutes is beneficial; duodenal lavage may be helpful in some instances. In milder types when a "rest cure" treatment is impossible the patient should assume the knee-chest posture immediately upon the onset of obstructive

symptoms. In other instances, relief is obtained if the patient rests an hour or two following meals with the foot of the bed elevated and this should be continued until the attack disappears. Through these procedures the abdominal organs tend to gravitate upward and the drag upon the duodenum is thus at least temporarily relieved. A well fitting abdominal support should be worn when the patient is up and about. It is also advisable to impress the patient with the importance of maintaining good general nutrition since symptoms frequently recur due to loss of weight and undernutrition. In severe types with excessive vomiting and pain, jejunal feeding through the duodenal tube must be instituted.

Diet plays an important rôle in the management of these cases. It should be bland, of a high caloric, high vitamin content to secure gain in weight and especially deposition of intra-abdominal fat.

The constipation should be managed as far as possible without purgatives. Laxative food of a bland type should be prescribed, together with adequate doses of mineral oil. If necessary, severe constipation may be overcome by means of enemata of 4 to 6 ounces of cotton seed oil retained overnight. The essential problem is a medical one directed to the prevention of traction upon the duodenum and to the treatment of the visceroptosis. Surgical intervention should be delayed as long as possible and should be employed only as a very last resort. If surgical intervention finally becomes necessary, duodenojejunostomy is the most satisfactory procedure. Occasionally division of a constricting band is all that may be necessary. Radical surgical measures are not as a rule indicated.

SUMMARY

The intermittent type of duodenal stasis has not as yet been clearly defined. There is undoubtedly, however, a definite condition of this type which gives rise to symptoms and which should be recognized. In this affection no pathologic changes are present, except those produced by superior mesenteric artery pressure associated with visceroptosis, adhesions and bands, or spinal deformities, movable growths and masses involving the abdominal organs or ptosis of the right kidney producing pressure upon the duodenum. Intermittent duodenal stasis may likewise be brought about by lesions elsewhere in the digestive tract producing reflex disturbances of motility in the duodenum. This affection occurs most frequently in females during middle life. The symptoms are not always characteristic. They frequently manifest themselves in the form of bilious and migraine attacks, indigestion, headaches, and chronic constipation. The patients are usually of the enteroptotic type. The roentgenological signs of duodenal stasis are well defined and characteristic and may be the only means of arriving at a positive diagnosis. Due to the intermittent character of this condition, however, the stasis may be present at certain examinations and not at others, and repeated studies must therefore be undertaken. The definite proof of the presence of intermittent duodenal stasis is the demonstration of a definite prolongation of the emptying of the duodenum during or immediately following an attack.

In the treatment, a carefully regulated diet, maintaining the general nutrition, frequent postural change and abdominal supports are of benefit. The essential problem is directed to overcoming the traction upon the duodenum and the effects of the associated visceroptosis. Surgical intervention should not be advised except as a last resort, and when indicated duodenojejunostomy or division of constricting bands is the best procedure to be undertaken.

REFERENCES

1. FRIEDENWALD, J., and FELDMAN, M. Chronische intermittierende Duodenalstauung. *Arch. f. Verdauugsdr.*, 1933, *53*, 20–32.
2. FRIEDENWALD J., and MORRISON, T. H. Chronic duodenal stasis. *Internal. S. Digest*, 1930, *9*, 131.
3. FRIEDENWALD, J., MORRISON, T. H., and FELDMAN, M. Chronic duodenal stasis observations in twenty-four cases. *Am. J. M. Sc.*, 1929, *178*, 796–805.
4. HAYES, WM. VAN V. Intestinal stasis. *N. York J. M.*, 1914, *99*, 170.

Vol. XXXII, No. 2

CHOLANGIOGRAPHY*

NEW TECHNIQUE AND RESULTS

By JOSE A. SARALEGUI, M.D.
BUENOS AIRES, ARGENTINA

SINCE biliary liathiasis is such a common illness, and surgery the most usual and practical therapeutic indication, it is necessary to surround the operative procedure with all possible safeguards to insure the best success. We know that there are numerous complications which are apt to accompany biliary calculi during and after surgical intervention.

Cholangiography is a new procedure of roentgen exploration which permits a knowledge of the shape, the contents and the function of the biliary ducts.

During the operation it is often difficult to correctly explore, manually or instrumentally, the hepatic ducts, because of anatomical difficulties, as in the case of obesity or because of the frequent inflammatory conditions in the region, which hinder the close observation of the different structures, especially the common and hepatic ducts, the ampulla of Vater, the pancreas, etc.

On the other hand, the instrumental exploration of the duct is often not sufficient to prove or disprove the existence of stones in its interior. Besides, the presence of stones in the intrahepatic ducts is very difficult to diagnose, either clinically or roentgenologically.

We may expect that in the future cholangiography will give very valuable data in the complicated cases of biliary calculi which we believe no other present method of exploration can offer. Thus, we will be able to study the function of the biliary ducts and Oddi's sphincter, and to know their permeability, their position and their possible alteration.

Today, it is well known that great importance attaches to the physio-pathology of Oddi's sphincter so far as the painful and infectious conditions of the biliary ducts are concerned. The visualization of the pancreatic duct by cholangiography may be of great value in the future interpretation of the pathological conditions of this region.

Using this method, after the first simple operation for drainage, the result of the final operation will be much more satisfactory, because it is the only means of exploration that can assure us of the pathological condition of these ducts.

FIG. 1. Case 1. Large stone located in the end of the common duct, which is enlarged. The pancreatic duct is very well observed; no total occlusion.

We have been using this method since 1926 in the Rivadavia Hospital of Buenos Aires in all cases of operative biliary fistula. The increasing frequency with which these cases are being referred for our examination by surgeons is, no doubt, due to the valuable clinical findings which this technique has revealed.

At first, we used the iodized oils as a con-

* Read before the American Congress of Radiology, Chicago, Ill., Sept. 25–30, 1933.

trast medium, not having observed any serious reactions. However, due to the difference in density and the low miscibility of the oils, the roentgenographic shadows are not sufficiently clear to recognize the presence of calculi within the channels, although sometimes lacunar shadows lead us to suspect their presence. Also, the use of the oil preparations seems to alter the function of the sphincter of Oddi and the pancreatic duct and small intrahepatic ducts are never well visualized.

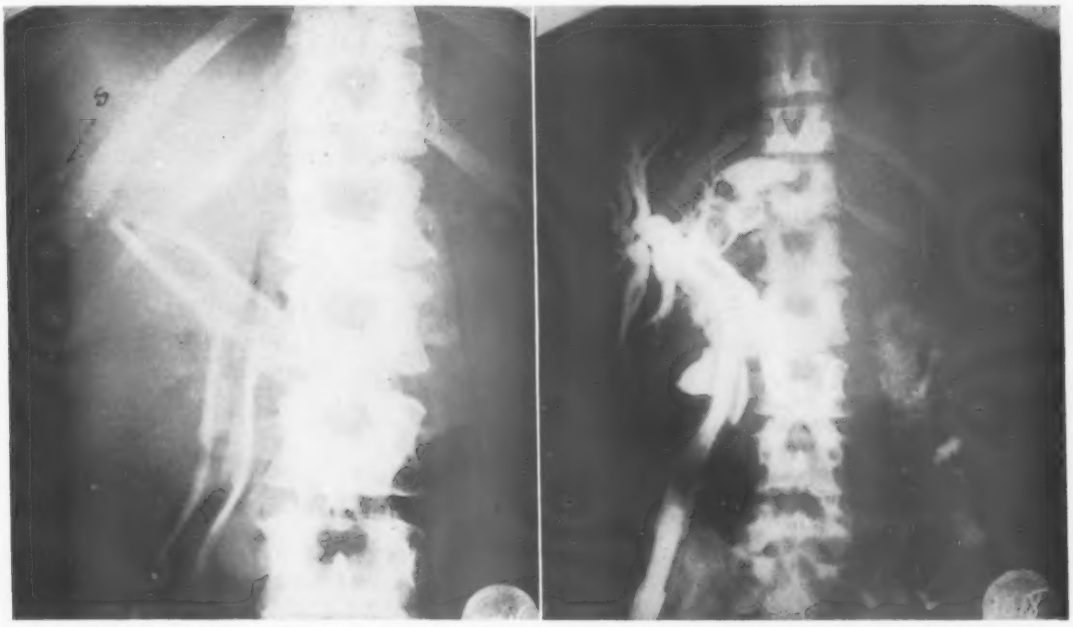
To overcome all these objections, we tried the aqueous solutions. In the beginning of our experiments, we used umbrathor, lithium, iodine and barium solutions, but some of them proved very painful. Now we employ the thorotrast of Heyden.

Fig. 2. Case II. Several large stones lodged in the common and intrahepatic ducts. It was possible to count the number of the stones very easily. Six days later the patient eliminated 5 or 6 stones through the fistula.

The technique is very simple. With the patient lying on his back, we begin the injection of the thorotrast, heated to 37° or 38° C., through the drainage tube, at the

Fig. 3. Case III. Stone in the middle of the common duct. No obstruction. The operative exploration could not determine its presence.

Fig. 4. Case IV. Stone the size of a small pea located in the end of the common duct. Total obstruction. Instrumental exploration was very difficult; impossible to determine its presence.



a *b*

Fig. 5. Case v. In the direct roentgenogram, *a*, a shadow was seen in the hepatic tissue which we could not interpret. Cholangiography, *b*, confirmed the diagnosis of intrahepatic stone.

same time guiding and observing the process through the fluoroscopic screen. It is necessary to inject enough opaque solution to be able to visualize all the intrahepatic ducts. Generally, 20 or 30 c.c. is sufficient, but more may be injected, if necessary, without danger. The retention of the solution in the ducts does not produce any reaction, even in cases of total obstruction of the common duct.

CASE REPORTS

Case I (2255–4 a/b). Patient, aged forty-three, with very marked jaundice for twenty-five days. Hepatic colic.

Operative Results. Deep palpation is painful. The head of the pancreas is enlarged. Pericholecystitis. Common duct not visible. Cystic duct deeply situated and difficult to dissect. Some calcareous concretions with mucopus.

Roentgen Findings. Cholangiography showed a stone in the orifice of the common duct, with almost total obstruction. All channels enlarged. The pancreatic duct was very well visualized in its entire length (Fig. 1).

Case II (2459–5). Patient obese, suffering ten years with hepatic colic. A year ago a painful crisis and transitory attacks of jaundice and fever. For the past thirty-five days, he has suffered a total painless jaundice. Cachexia.

Operative Findings. Large gallbladder filled with stones. No pericholecystitis. Common duct visible and somewhat enlarged. In the cystic duct, it was possible to palpate the stone and remove it. A drainage was established and the operation rapidly ended, due to the serious condition of the patient.

Roentgen Findings (Fig. 2). Twenty days later, cholangiography revealed a number of large stones lodged in the common and other intrahepatic ducts. No obstruction of the sphincter of Oddi. The same afternoon the patient eliminated six stones with no pain. Six days later another examination with thorotrast was made, still revealing the presence of several stones as well as the dilatation of the biliary channels.

Case III (2881–a/b). Patient, aged thirty, suffering from biliary calculi, with alternating crises of pain and jaundice.

Operative Results. Gallbladder filled with stones. Cystic duct slightly enlarged. Palpation very difficult due to inflammatory condition. Instrumental exploration did not reveal any stones in the common duct. Drainage established.

Roentgen Findings. Cholangiography revealed the presence of one stone in the middle

of the common duct. No enlargement of the channel and permeability. The thorotrast solution flowed easily into the duodenum (Fig. 3).

Case iv (2800–2 a/b). Patient, aged thirty-four, suffering eight months from hepatic colic, fever and jaundice.

Operative Results. Gallbladder sclerotic and atrophied. Palpation difficult. Obese patient. Instrumental exploration revealed slight resistance at the end of the common duct. Cause of jaundice not clear.

Roentgen Findings. Cholangiography made four days later revealed a stone the size of a small pea located in the end of the common duct. Marked dilatation of the ducts (Fig. 4). A second operation was done and the stone removed by duodenostomy.

Case v (3018–3). Patient, aged fifty-two, suffering repeated attacks of hepatic colic and jaundice.

Operative Results. Palpation difficult. Adhesions to the duodenum. Common duct not visible. Small gallbladder without stones, but diseased. Enlarged cystic duct. Head of the pancreas enlarged. Instrumental exploration negative. Some resistance at the end. Impossible to affirm the presence of a stone

Roentgen Findings. Films taken without opaque solution (Fig. 5, *a*) showed a small shadow in the hepatic tissue, making interpretation difficult. Later, cholangiography revealed that this shadow was a small stone located in the small channel. Enlarged common duct. No other stones (Fig. 5, *b*).

Vol. XXXII, No. 2

THE MIGRATORY CECUM

By JACOB BUCKSTEIN, M.D.
NEW YORK CITY

THE COLON is embryologically derived from the endgut, and in the course of its gradual development to the characteristic structure of the adult goes through a series of interesting changes that throw considerable light upon many of the anomalies of form and position encountered in a study of this region.

The alimentary tract is originally a straight tube, from which, at about the fifth or sixth day of embryonal life, a portion becomes differentiated as the future stomach. The part below this continues to grow considerably in length, becoming longer than the body cavity. In addition, a differentiation into small and large intestine occurs, marked by the development of a cecal bud. The proximal portion of the cecal bud develops into the cecum proper, while the terminal portion becomes the appendix. Beyond this is that part of the loop from which the ascending and transverse colon is developed.

From the most distal portion are developed the splenic flexure, descending colon, sigmoid and rectum.

From then on, there is a gradual rotation of the cecum over towards the right side in the upper quadrant and then a gradual descent, until it occupies the right lower quadrant. As the fetal liver gradually diminishes in size, the hepatic flexure becomes more clearly defined. An interesting migration is thus traced which, beginning with the fourth month of fetal life, carries the cecum from its original position in the left lower quadrant to the position it normally occupies in the adult. Coincident with this transposition is a rotation of the small intestine to the left. The sigmoid shows differentiation during the third month.

Almost every degree of arrested rotation of the cecum may be demonstrated in the adult. With this failure of rotation is also associated a failure of rotation on the part of the small intestine. Indeed, our first suspicion of a congenitally anomalous position of the colon may be indicated by the fact that on roentgen examination a malposition to the right is found of the jejunal coils. Both incomplete descent and increased descent of the cecum have been described.

The practical bearings of such anomalies of position are at once evident. Particularly is this true of appendicial disease, where an abnormal position of the cecum is coincidentally associated with a correspondingly abnormally situated appendix.

The final descent of the cecum into the right iliac fossa occurs in the eighth month of intrauterine life.[9]

Failure of rotation of the cecum may result in a wide range of variation in its position, as indicated in the accompanying table, based on 1,050 autopsies of infants performed at the New York Foundling Hospital.

Cecum on left side of abdomen with failure of rotation of the intestine	Male	2
	Female	3
		5
Cecum undescended lying between the under surface of liver and right iliac chest	Male	31
	Female	32
		63
Cecum in the right iliac fossa	Male	443
	Female	439
		882
Cecum in the pelvis	Male	34
	Female	66
		100
		1,050

Anomalies of congenital origin in the position of the colon, and more particularly of the cecum, and the clinical significance of such variations was brought out by Curschmann.[7] In 2 cases, proved by autopsy, the cecum being present in the right upper quadrant, the appendix was

Fig. 1. Usual position of the cecum.

similarly situated, and its perforation led to the formation of an abcess in the region of the liver.

With fixation of the cecum in the right upper quadrant, the ascending colon by continuing to develop, may assume a V shape in appearance. This produces an inverted position of the cecum and ascending colon.[14]

A careful study of the roentgen demonstration of various types of non-rotation of the cecum is that of Payne and Trahar.[16] Equally interesting is a consideration of complete transposition of the viscera, where the cecum is in the left lower quadrant and the sigmoid on the right side. In other words, the actual relationship of the different parts of the colon to each other is normal, but in relation to the body an entire reversal of position affecting all parts similarly has occurred.

LeWald refers to a remarkable association of non-rotation of the colon with complete transposition, which came to his attention and was demonstrated at an autopsy of an infant in the Babies Hospital, New York City. As far as the final position of the cecum was concerned, it was on the right side, the two types of anomaly having neutralized each other.

Considerable interest in this country in the subject of the relation of the position of the cecum to disorders of digestion has been created by the stimulating papers of Kautor.[11a,11b]

The clinical significance of the low cecum has been a debatable subject.

It appears, unfortunately, in a study of the position of the abdominal viscera in relation to disorders of digestion that insufficient attention has been directed to normal variations in position in health.

The study of Moody[15] on 1000 healthy students at the University of California is therefore particularly valuable. Most commonly the lowest point of the transverse colon was 3 to 4 inches below the interiliac line in 33 per cent of the males and 49 per cent of the females, and more than 5 inches below in 16 per cent of the males and 21 per cent of the females. He states: "These low colons have not fallen from the upper regions but are in their normal positions."

Fig. 2. Normal distribution of the small intestine. Note that the jejunal coils are to the left and the ileal coils to the right.

Particularly significant are the figures he quotes which were obtained from a roentgen study of 150 healthy students at the University College in London, regarding the position of the cecum. Thus, in 91 per cent the lowest point of the cecum was below the interiliac line (45.6 per cent of cases).

> The ability of the abdominal viscera to function does not depend on their position. Low viscera function as normally as high viscera; therefore low viscera should not be considered a cause of disease. . . . Low stomachs, low colons, low cecums, low livers and low spleens are so common in healthy young adults that diagnoses of enteroptosis, gastroptosis and coloptosis are seldom or never justifiable.

Certainly the diagnosis should be made with much greater caution than it ordinarily is. Only clear evidence of definite disturbance of function should be accepted as a basis for the diagnosis of a pathologic condition.

Carslaw[5] wrote:

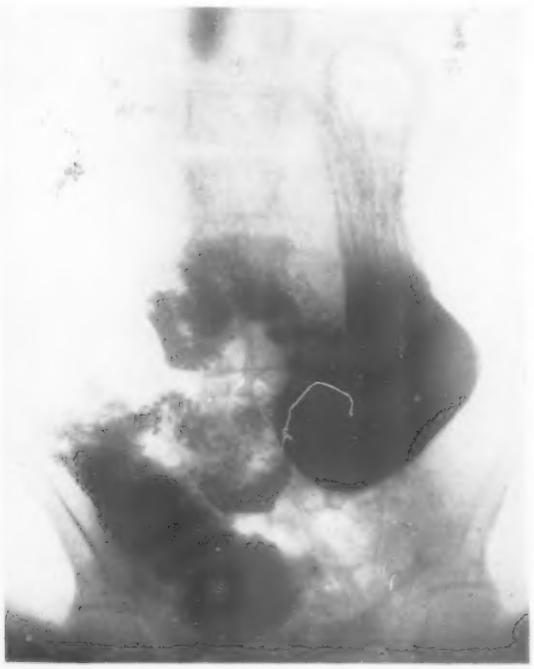


Fig. 3. Non-rotation of the small intestine with non-rotation of the cecum. Note that the jejunal coils are all to the right.

Fig. 4. Colon showing complete failure of rotation with the cecum on the left side.

> Many children are undoubtedly born with developmental membranes and a considerable degree of congenital ptosis who do not develop any symptoms of stasis. Thus we find many healthy adults with visceroptosis, people who are in good health although the stomach may reach below the interiliac line, and the cecum hang well over the pelvic brim. . . .
>
> As visceroptosis may be unaccompanied by any symptoms, and is indeed often found in those in perfect health, great care must be exercised in deciding that the clinical condition in any particular case is due to visceroptosis. It is not sufficient to be satisfied that the condition could be accounted for by visceroptosis; one must exclude the possibility of its being due to other pathological conditions.

In this connection the warning of Hurst[11] is significant regarding the remarkable variations which may occur in normal individuals as to the rapidity with which the intestinal contents pass through the bowel, and the delay in each segment.

> The times I gave in 1907 as the average rate for the passage of the intestinal contents in

Fig. 5. Complete failure of rotation of the cecum.

Fig. 6. Failure of descent of the cecum with continued growth of the ascending colon producing an inverted type of cecum.

healthy individuals were nothing more than the average, though they have often been taken as the "normal" times, the slightest divergence from which has been regarded as pathological. Healthy individuals, however, vary within wide limits in this direction, and the position and mobility of the cecum, ascending and transverse colon are also subject to considerable variations. It is not pathological for the cecum to drop into the pelvis in the erect position, and a powerful forward in the Guy's fifteen of 1907, who had never had a day's indigestion or constipation, was only one of several perfectly healthy individuals I have seen with the greater curvation of the stomach over two

Fig. 7. Note inverted position of the cecum.

inches below the umbilicus and the transverse colon reaching almost to the bottom of the pelvis.

Ptosis of the colon hardly ever gives rise to symptoms by causing kinks, and stasis in the colon must be considerable before it can be regarded as of real importance.

In addition to variations in the position of the cecum due to anomalies of rotation is the changing position of the cecum because of abnormal mobility.

Robinson[17] in 1902 recognized the potential clinical significance of the mobile cecum which by its drag might produce pain

through traumatization of the nerve supply, and might also interfere with the blood and lymphatic circulation.

Hausmann,[8] in 1904, reported his experiences with "caecum mobile." Constipation and attacks of colicky pain generally, though not always, present on the right side of the abdomen may occur. The pain may result from mild or marked volvulus, due to the increased mobility of the cecum as the result of an abnormally long mesentery.

Fig. 8. Incomplete descent of the cecum. Note position of the appendix.

Wilms[22] noted that in many of the cases of "chronic appendicitis" the pain at McBurney's point could not be explained by the pathologic appearance of the appendix. Many of these cases have a long mobile cecum which acts as a cause of pain in the right lower quadrant, by tension on the nerves, with stasis as an important factor in increasing the traction. Colicky attacks of right-sided pain may result.

In a further study of the subject, Wilms[23] summarizes the symptoms as recurrent

Fig. 9. High fixation and transverse position of the cecum due to failure of descent. Note the location of the coils of small intestine.

colicky attacks of pain on the right side of the abdomen, though slight painful sensations may be present continuously, a rumbling noise on palpating the cecum, stagnation of bismuth in the cecum on roent-

Fig. 10. High position of the cecum.

Fig. 11. Rotation of the cecum although occupying the right side so that the ileocecal junction is present laterally.

gen examination, constipation alternating with diarrhea.

According to Alglave,[1] an extremely mobile ileocecal segment (in which he includes the ileocecal valve, cecum and the first 5 or 6 centimeters of the ascending colon) represents a reversion to a lower type. This segment is very mobile in the ape, and other vertebrates. In the carnivora, such as the dog, the segment displays an extreme degree of mobility and may be found in any part of the abdomen.

In a study of 100 fresh bodies of individuals who had died of conditions other than of abdominal disease, Treves[21] found the following:

> The mobility of the cecum is often considerable. . . . In eleven bodies I have met with ceca that could be made to touch the under surface of the liver, and any part of the left side of the pelvis. In some of these specimens, the cecum might very well have occupied an inguinal or femoral hernia on the left side, had the hernial orifice been large enough. In one case the tip of the cecum could be made to touch the xiphoid cartilage, and in several instances the mobile piece of intestine could be drawn down the thigh to the level of the great trochanter.

The mobile cecum is due to an abnormally long mesentery, the result of arrested development[4] and in itself should not be considered a pathologic anomaly,[3] though under certain conditions its abnormal behavior may simulate chronic appendicitis.[19]

It may occur at any age and is predominantly more common in females.[12]

According to Stierlin,[20] the following clinical symptoms may be present because of a "caecum mobile," particularly as the result of kinking or axis rotation: (1) Colicky attacks of pain occurring at intervals with localization preponderatingly in the region of the cecum and ascending colon, generally without fever; (2) chronic constipation, usually of a severe degree, occasionally alternating with diarrheas of short duration, especially following attacks

Fig. 12. Cecum present on the left side although the rest of the colon occupies a normal position (hyper-rotation).

of colicky nature; (3) a tumor in the region of the cecum, which feels as if it contained fluid and air. Confirmation depends on roentgen examination, demonstrating abnormal mobility of the cecum together with dilatation and stasis within it.

Of 80 cases operated on by Klose[12] with symptoms of so-called chronic appendicitis, in 15 per cent the symptoms were due to a mobile cecum. He attempts a differential diagnosis from chronic appendicitis on the following basis: the occurrence in cecum mobile of intermittent fever-free colics, the attacks generally preceded by a period of constipation and flatulence, with relief of pain after a bowel movement. On physical examination the cecum may be palpable, and a gurgling present. Roentgen examination establishes the diagnosis.

According to Béclère and Mériel,[2] the mobile cecum is not pathologic and is compatible with perfect health. It is rather the abnormally prolonged stagnation of contents in the cecum and ascending colon with secondary dilatation of the cecum that is responsible for development of symptoms.

The symptomatology of the mobile cecum and ascending colon when loaded with its contents has similarly been described by Carslaw[5] as that of right-sided pain, due to occasional overdistention of the cecum, or varying degrees of volvulus. Constipation may alter with outbursts of diarrhea. Evidences of toxic absorption may be present.

Distress related to food may be brought about by the traction of a ptosed right colon producing increased tension on the transverse portion of the duodenum with the production of a chronic duodenal ileus. Similarly such traction may produce a drag upon the gallbladder, stomach and right kidney.

Medical measures consist of treatment of the associated intestinal stasis. Proper abdominal support and measures employed in the treatment of the enteroptotic may be useful. An important point from the standpoint of dietetic therapy is the observation of Klose[13] that the more severe attacks may be brought on by a cellulose rich diet.

Cecal fixation has been recommended by Wilms, Klose and Stierlin.

Coffey[6] has emphasized the value of surgery in some cases of mobile cecum and ascending colon.

More recently surgery has been warmly recommended by Houston.[10] He reported his results in 145 colopexies. The pain simulating chronic appendix disappeared, as well as associated dyspeptic symptoms. No operative mortality was present.

REFERENCES

1. Alglave, P. Contribution à l'anatomie chirurgicale et comparée du segment iléo-caecal de l'intestin, de l'adulte. *Bull. et mém. Soc. anat. de Par.*, 1907, *82*, 124–151.
2. Béclère and Mériel. L'exploration radiologique dans les affections chirurgicales de l'estomac et de l'intestin. *Arch. gén. de chir.*, 1913, *9*, 45–58.
3. Bensaude, R., Guénaud, G., and Constantin, P. L'examen radiologique dans la constipation habituelle. *J. méd. franc.*, 1919, *8*, 255–272.
4. Brosch, A. Das Dickdarmproblem. *Wien. med. Wchnschr.*, 1910, *60*, 1149; 1210; 1276.
5. Carslaw, R. B. Right-sided visceroptosis. *Brit. J. Surg.*, 1927–1928, *15*, 545–604.
6. Coffey, R. C. The relation of right-sided abdominal pain to right-sided disease. *J. Am. M. Ass.*, 1923, *81*, 900–904.
7. Curschmann, H. Die Anomalien der Lage, Form und Grösse des Dickdarms und ihre klinische Bedeutung. *Deutsches Arch. f. klin. Med.*, 1894, *53*, 1–33.
8. Hausmann, T. Das Coecum mobile. *Berl. klin. Wchnschr.*, 1904, *41*, 1153–1154.
9. Hertwig and Keith. Quoted by Smith, ref. 18.
10. Houston, W. R. The mobile right colon. *J. Am. M. Ass.*, 1929, *93*, 766–768.
11. Hurst, A. F. Sins and sorrows of the colon. *Brit. M. J.*, 1922, *1*, 941–943.

11*a*. Kantor, J. L. A clinical study of some common anatomical abnormalities of the colon. II. The low cecum. Am. J. Roentgenol. & Rad. Therapy, 1925, *14*, 207–215.

11*b*. Kantor, J. L., and Schechter, S. Colon studies. V. The high cecum. Am. J. Roentgenol. & Rad. Therapy, 1928, *19*, 101–111.

12. Klose, H. Klinische und anatomische Fragestellungen über das Coecum mobile. *Beitr. z. klin. Chir.*, 1909, *63*, 711–741.
13. Klose, H. Das mobile Coecum mit seinen Folgezuständen und die chirurgische Behandlung ptotischer Erkrankungen des Magendarmkanales. *Beitr. z. klin. Chir.*, 1911, *74*, 593–714.
14. MacLean, A. B. Undescended caecum. *Glasgow M. J.*, 1925, *103*, 352–355.
15. Moody, R. O. Are diagnoses of enteroptosis, gastroptosis and coloptosis now justified? *Am. J. Surg.*, 1929, *7*, 470–473.
16. Payne, R. A., and Trahar, F. C. Developmental rests in the cecum and ascending colon and their roentgen-ray diagnosis. Am. J. Roentgenol., 1921, *8*, 643–653.
17. Robinson, B. The cecum: In relation to the psoas muscle in 310 adult male and 125 adult female autopsies. *St. Louis Cour. Med.*, 1902, *27*, 426–435.
18. Smith, G. M. A statistical review of the common variations in the anatomic positions of the caecum and the processus vermiformis in the infant. *Anat. Rec.*, 1911, *5*, 549–556.
19. Stierlin, E. Ueber einige Störungen des Colonfunktion. *Cor.-Bl. f. schweiz. Aerzte*, 1910, *40*, 1170–1172.
20. Stierlin, E. Das Coecum mobile als Ursache mancher Fälle sog. chronischer Appendicitis und die Erfolge der Coecopexie. *Deutsche Ztschr. f. Chir.*, 1910, *106*, 407–476.
21. Treves, F. The anatomy of the intestinal canal and peritoneum in man. *Brit. M. J.*, 1885, *1*, 470–474.
22. Wilms. Fixation des Coecum mobile bei Fällen von sogenannter chronischer Appendicitis. *Centralbl. f. Chir.*, 1908, *35*, 1089–1091.
23. Wilms. Chronische Appendizitis, Caecum mobile. *Arch. f. klin. Chir.*, 1911, *95*, 581–594.

Vol. XXXII, No. 2

AN ANALYSIS OF ONE THOUSAND CONSECUTIVE EXAMINATIONS OF THE STOMACH AND DUODENUM FROM THE CLINICAL, ROENTGENOLOGIC, AND SURGICAL VIEWPOINTS*

WITH PARTICULAR REFERENCE TO THE INCIDENCE, DIAGNOSIS, AND TREATMENT OF GASTRIC AND DUODENAL ULCER AND CARCINOMA OF THE STOMACH

By NELSON M. PERCY, M.D., *Surgeon-in-chief*
and
DAVID S. BEILIN, M.D., *Radiologist*
Augustana Hospital
CHICAGO, ILLINOIS

THE Division of Vital Statistics at Washington has some striking figures in its most recent report. In 1931, there were 4,978 deaths from ulcer of the stomach, and 2,281 from ulcer of the duodenum, with respective rates of 4.2 and 1.9. For the same year, 25,397 deaths occurred from cancer of the stomach, or a rate of 21.3. There was a total of 118,141 who died from cancer and other malignant tumors; that is, over one-quarter of the deaths from all forms of malignancy were due to cancer of the stomach. Although the above figures are somewhat relative, the fact remains that carcinoma of the stomach continues to lead the list of deaths from malignancy, and further progress in the prevention and treatment of gastric carcinoma, as well as peptic ulcer, cannot be made until the general profession, as well as the public, are made aware of facts and accept them as they are today.

Many contributions have been presented on the various phases of the gastric carcinoma-ulcer problem. We are particularly interested in the early diagnosis of carcinoma of the stomach, for therein lies the only hope of a cure. It was with this purpose in mind that the present study was made. The entire group of cases had the routine clinical and roentgenologic studies. The clinical diagnoses in this series were checked by surgery and roentgenologically. Those cases which did not go to surgery, comprising relatively a small number, were checked therapeutically.

INCIDENCE OF ULCER OF THE STOMACH AND DUODENUM

In 1,000 consecutive examinations of the stomach and duodenum, there were 21 gastric ulcers, or 2.1 per cent, and 171 duodenal ulcers, or 17.1 per cent. An analysis of the gastric ulcers revealed the youngest age was fifteen years, the oldest, sixty-nine years, and the average age, forty-seven years. For duodenal ulcers, the youngest age was eighteen years, the oldest, seventy-four years, and the average age, forty-five years. It is obvious from this study that the incidence of ulcer of the stomach and duodenum as to age is rather similar. However, as to sex, there were 52.3 per cent gastric ulcers in the male and 47.6 per cent in the female. There was a striking difference as to the incidence of duodenal ulcers; namely, 68.4 per cent in the male, and 31.5 per cent in the female. In this study, the incidence of duodenal ulcer to gastric ulcer was 8 to 1.

INCIDENCE OF CANCER OF THE STOMACH

In 1,000 consecutive examinations of the stomach, there were 71 cancers, or 7.1 per

* Read before the American Congress of Radiology, Chicago, Ill., Sept. 25-30, 1933.

cent. The youngest age was twenty-six years, the oldest, eighty-three years, and the average age, fifty-eight years. As to sex, 62 per cent occurred in the male; whereas 38 per cent occurred in the female. This study revealed that the incidence of cancer of the stomach predominated in the fifth and sixth decades of life, as well as shows that it is almost twice as common in males as in females.

ROENTGENOLOGIC ANALYSIS OF THE LOCATION OF GASTRIC ULCER

Four and one-tenth per cent of the gastric ulcers occurred in the upper one-third of the stomach on the lesser curvature side; 20.8 per cent occurred at the middle one-third on the lesser curvature side; 12.5 per cent at the lower one-third on the lesser curvature side, and 26.5 per cent at the region of the pylorus.

ROENTGENOLOGIC ANALYSIS OF THE LOCATION OF CARCINOMA OF THE STOMACH

Eight and two-tenths per cent occurred at the upper one-third; 12.3 per cent occurred at the middle one-third; 78 per cent occurred at the lower one-third. The entire stomach was involved in 1.3 per cent.

AN ANALYSIS OF THE CARDINAL CLINICAL FINDINGS OF ULCER OF THE STOMACH

This study revealed the outstanding finding that all the gastric ulcer cases had pain. In 85.7 per cent of cases the pain was in the epigastrium and in 14.2 per cent the pain was diffuse. The pain was sharp in 52.3 per cent; dull in 23.8 per cent; burning in 14.2 per cent, and gnawing in 9.5 per cent. Nausea occurred in 52.3 per cent; vomiting occurred in 52.3 per cent; vomiting of blood occurred in 9.5 per cent; indigestion or gas in 57.1 per cent. The number of cases relieved by food, soda, or drugs was 28.5 per cent. Occult blood or tarry stools occurred in 23.8 per cent; weakness in 38 per cent; anemia in 9.5 per cent; loss of weight in 42.8 per cent. The greatest loss of weight was 30 lb., the smallest 3 lb., and the average 11.3 lb. The duration of symptoms was interesting: the longest duration was twenty years; the shortest four months, and the average, 4.1 years. The blood picture was not remarkable and of no particular clinical significance.

AN ANALYSIS OF THE CARDINAL CLINICAL FINDINGS OF ULCER OF THE DUODENUM

This study revealed that all the duodenal ulcer cases had pain, with the exception of 7.6 per cent. The type of pain or distress in duodenal ulcer was somewhat protean in character. Sharp pain was manifested in 31.5 per cent; gnawing pain in 8.1 per cent; dull or aching pain in 39.7 per cent; cramping pain in 7 per cent; burning or heartburn in 17.5 per cent; no pain in 7.6 per cent. As to the location of pain in duodenal ulcer, 75.8 per cent had pain in the epigastrium; 26.9 per cent had pain in the right upper quadrant; 4.6 per cent had pain in the left upper quadrant; 4 per cent had diffuse pain over the entire abdomen. It was not uncommon for many patients to complain of pain in both the epigastrium and right upper quadrant. It was very striking to note that 76.4 per cent of the cases of painless duodenal ulcer had hemorrhage or bleeding. Nausea occurred in 52.6 per cent; vomiting in 56.1 per cent; vomiting of blood in 6.4 per cent; indigestion or gas in 70.1 per cent. The number of cases relieved by food, soda, or drugs was 54.3 per cent. Tarry stools and occult blood occurred in 46.2 per cent; weakness in 42.5 per cent; loss of weight in 48.6 per cent. The greatest weight loss was 61 lb., the smallest 3 lb., and the average, 17.2 lb. It was interesting to note the duration of symptoms. The longest duration was thirty years; the shortest, one day (very unusual case, No. 61); the average 5.4 years. The blood picture in duodenal ulcer revealed that the average red blood count was 3,987,000; the average white blood count, 8,238; the average hemoglobin, 63 per cent.

It was of interest to observe the number of cases of duodenal ulcer that had had previous medical or surgical treatment for

that condition. The number of cases that had had medical treatment was 43.2 per cent; surgical treatment, 9.3 per cent. The number of cases of duodenal ulcer that had had appendectomies was 32 per cent; cholecystectomies, 18 per cent.

AN ANALYSIS OF THE CARDINAL CLINICAL FINDINGS OF CANCER OF THE STOMACH

THESE CASES WERE ANALYZED AND GROUPED ACCORDING TO THE DURATION OF SYMPTOMS

Group I. Cases under three months' duration.
Group II. Cases from three to six months.
Group III. Cases from six months and up.
Group IV. Study of entire group.

	Group I (under 3 months)	Group II (3 to 6 months)	Group III (6 months and up)	Group IV (entire group)
Number of cases	18.8%	22.5%	59.1%	100%
Pain	A. Distress 61.8% B. Dull 30.7% C. Heavy feeling 0.76%	A. Sharp 25.0% B. Burning 43.7% C. Heavy feeling 12.5% D. Distress, etc. 20.0%	A. Sharp 35.7% B. Burning 30.9% C. Heavy feeling 7.1% D. Distress, etc. 26.1%	A. Sharp 36.6% B. Burning 33.8% C. Heavy feeling, distress, etc. 19.0% D. No pain 14.0%
Location of pain	All epigastrium	All epigastrium	Epigastrium and right upper quadrant	Epigastrium and right upper quadrant: 86% had pain; 14% had no pain
Nausea	92.3%	50.0%	47.6%	56.3%
Vomiting	84.6%	43.7%	61.0%	61.0%
Vomiting blood	23.0%	6.2%	2.3%	7.0%
Gas and indigestion	76.9%	56.2%	45.2%	53.5%
Relieved by food, soda, or medicine	0.76%	13.1%	9.5%	9.8%
Bleeding, tarry stools, occult blood	53.8%	68.7%	23.8%	39.4%
Weakness	69.2%	56.2%	71.4%	67.6%
Loss of weight (average)	16.7 lb.	18.1 lb.	24.3 lb.	1. Greatest 80 lb. 2. Smallest 1 lb. 3. Average 21.5 lb.
Duration of symptoms				Longest duration 2 yr. Shortest duration 3 wk. Average duration 8.5 mo.

Blood picture				Red blood cells average 3,663,000 Hemoglobin average 58.7% White blood cells average 9,978
Number of cases with obstruction	40 cases of carcinoma or 56.3% had varying degrees of obstruction.			

	Duodenal Ulcer	*Gastric Ulcer*		*Carcinoma*
Percentage of ulcers and carcinomas by decades	10 to 20 years	0.58%	4.7%	none
	20 to 30 years	14.6%	none	1.4%
	30 to 40 years	26.0%	33.3%	5.6%
	40 to 50 years	22.2%	14.2%	14.0%
	50 to 60 years	20.4%	28.5%	36.6%
	60 to 70 years	12.2%	19.0%	29.5%
	70 to 80 years	3.5%	none	9.8%
	80 to 90 years	none	none	2.8%

THE DIAGNOSIS OF ULCER AND CARCINOMA OF THE STOMACH AND DUODENUM

A review of the literature reveals that very little has been added in the last decade from the diagnostic side except by the roentgenologist. Thorough clinical and competent roentgenologic studies will practically always result in an accurate diagnosis. Very often the clinical syndrome in peptic ulcer is clear cut and the diagnosis offers no difficulty. However, too frequently, the symptomatology is indefinite, as well as protean in character, and one cannot make a conclusive diagnosis from the clinical findings alone. It is particularly in these atypical cases that the roentgen examination is of paramount importance.

The symptoms of gastric and duodenal ulcer are relatively similar. In the paragraphs pertaining to the analysis of the cardinal clinical findings of ulcer of the stomach and duodenum, one may note the difference in incidence of the various symptoms, which study reveals that the differential diagnosis between ulcer of the stomach and duodenum cannot be conclusively relied upon as there are no pathognomonic clinical symptoms of either condition. However, a competent roentgen examination of the stomach and duodenum will reveal the signs of gastric or duodenal ulcer in 98 per cent of the cases.

The stomach has the distinction of being affected more frequently with carcinoma than any other organ of the body. One of the greatest difficulties is that the patient is slow to realize that he is seriously ill. Many patients who early see one or more doctors are allowed to drift along for what is supposed to be an ulcer or a functional disturbance of digestion.

Unfortunately the early symptoms of cancer of the stomach are so vague and indefinite in character that this condition cannot be diagnosed clinically in its early stages. An analysis of the studies of various observers, as well as our own, on the symptoms of carcinoma reveal the following early symptoms:

Gas, distress in the epigastrium or so-called "indigestion," associated with varying degrees of nausea were the earliest symptoms complained of by the patients in this series. It is obvious that no clinical diagnosis of carcinoma can be made on this syndrome. Such a syndrome occurring in an individual, particularly a male in the cancer age (fifth and sixth decade), who

has not had previous stomach trouble for years, should have an immediate competent roentgen examination of the stomach to exclude early carcinoma.

It should be mentioned that the next most frequent early symptoms were weakness and unaccountable loss in weight, and the "indigestion" was not relieved by food or soda. The other symptoms were beyond the pale of early carcinoma.

Laboratory findings other than the roentgenologic are of little value in differentiating between gastric ulcer and gastric carcinoma. In our cases in which the examination was made, occult blood was found in the stools of 90 per cent of cases, and in the stomach contents the percentage was approximately the same. These findings are significant of ulceration somewhere in the intestinal tract, but does not signify that the ulceration is carcinomatous in character.

Anemia is always present, but the degree is by no means constant. Until recently, too much reliance has been placed upon the gastric analysis in the diagnosis of cancer of the stomach. The absence of free hydrochloric acid is by no means pathognomonic of cancer.

Hartment reports free hydrochloric acid in 50 per cent of cases of cancer of the stomach studied at the Mayo Clinic. Alvarez* states, "A study of gastric acidity in cases of carcinoma of the stomach is usually of no value. It fails us in just the type of case in which we need help the most; that is, in the case of questionable gastric ulcer."

Alvarez found that there is a great difference between the acidity found in the cancer cases in which the lesion has given rise to a fairly large series of ulcer-like symptoms, and the acidity in cases in which the history is short and the symptoms not those of ulcer. The gastric acidity in cases of benign gastric ulcer is practically the same as in malignant gastric ulcer.

The most dependable means of diagnosis of early carcinoma of the stomach is a roentgen examination by a competent roentgenologist.

Cancer of the stomach is a surgical condition, and like cancer of the breast and in most other regions is curable if operated upon early, and is hopeless if the growth has progressed to a stage in which thorough removal is impossible.

It is a lamentable fact that by the time the case of cancer of the stomach comes to the surgeon approximately 50 per cent have reached a stage in which not even an exploratory operation is indicated. In the other 50 per cent in which an exploration is warranted the growth can be removed in only about one-half of such cases. Thus it will be seen that only 25 per cent of cases of cancer of the stomach are operated on at a time when an attempt at a cure can be made.

The appalling situation is due to two major reasons: first, the failure to make an early diagnosis, and second, the prevailing attitude of many physicians and of the layman toward the disease. Oftentimes, when a diagnosis of cancer of the stomach is made, the physician at once considers the disease as incurable and advises against surgery.

While the roentgen examination is the most dependable means of making a diagnosis of cancer of the stomach, it is not always so accurate in determining the operability of the case. Oftentimes the roentgenologist submits a report of an examination of a case of cancer of the stomach and supplements the report by saying that in all probability the case is inoperable. This often forestalls the likelihood of the case being seen by the surgeon. Not infrequently, what appears to be an inoperable case from a roentgenologic standpoint is not from a surgical one. In any event, an unfavorable roentgenologic report should not deter one from opening the abdomen in the hope of doing at least a palliative operation.

When a diagnosis of cancer of the stomach is made, the responsibility must be assumed by the surgeon. As a rule, all cases of

* *Proc. Staff Meet. Mayo Clinic*, May 3, 1933.

cancer of the stomach should be explored unless irremovable metastatic growths can be demonstrated. When rectal, umbilical, or supraclavicular metastases can be demonstrated, exploration is not indicated except when marked obstruction is present. In such cases, a gastroenterostomy may afford the patient much relief.

The curability of cancer of the stomach was illustrated by Balfour in the symposium on carcinoma presented at the Clinical Congress of Surgeons in New York, in 1931, when he reported a group of 278 patients who had lived for five years or more following removal of carcinomas of the stomach, stating that five-year cures could be obtained in 50 per cent of the cases in which the lymph nodes were not involved.

SURGICAL TREATMENT

As soon as cancer of the stomach is recognized or suspected, an abdominal exploration should be advised, unless irremovable metastatic growths are known to exist. Oftentimes an exploration will prove a resection is possible when both the clinical and roentgenologic evidence look as though it were impossible. The presence of a large palpable tumor is not necessarily a contraindication to radical surgery. The large tumors of the stomach are usually of the colloid type of cancer, and frequently freely movable without involvement of the surrounding structures, making an extensive resection practical. Involvement of regional lymph glands is not a contraindication to radical resection as they are sufficiently accessible, especially those of the greater and lesser curvatures, that they can often be thoroughly removed.

From the standpoint of location of the growths, the most favorable sites for operability are, first, the body of the stomach; second, the fundus, where growth involves the greater curvature and posterior wall; third, the antrum with extension to the pylorus. The later lesions frequently extend high along the lesser curvature and then the only procedure is a complete gastrectomy. From the roentgenologic point of view, cancers of the pylorus involving the antrum are considered to be the most favorable for both removal and cure. Experience has proved this not to be true. In this region, the lymph nodes are numerous and become involved early and cannot be so thoroughly removed as in other regions of the stomach. Furthermore, penetration posteriorly into the pancreas is apt to occur early and lessen the chance of a cure. Cancer of the middle portion of the stomach offers the greatest chance of a cure, because it is most accessible and its regional lymph glands can be thoroughly removed. High-lying cancers shown by the roentgen ray as involving the posterior wall and greater curvature, and even extending into the fundus, should not be considered hopeless. Exploration should always be advised, as this portion of the stomach can often be mobilized and a radical resection made with a prospect of a cure.

The surgical treatment of cancer of the stomach has two purposes in view: first, an attempt to cure; second, palliation. In dealing with cancer of the stomach, one should not be content to treat only the curable case, but should carry out any procedure which will make the remainder of the patient's life more comfortable. As a palliative measure, one of two procedures may be carried out: first, a palliative resection; that is, making a partial gastrectomy in patients who have irremovable metastatic growths. After a palliative removal of a large necrotic or ulcerating cancer of the stomach, patients often live from one to three years in comparative comfort.

Obstruction seldom occurs following a palliative resection, and death is usually due to metastasis in the liver. When obstruction is present and a palliative resection cannot be safely done, a gastroenterostomy will relieve the distressing vomiting, enable him to take sufficient nourishment to gain in weight, and often prolong life a period of twelve to eighteen months. It is not within the scope of this paper to

deal with the technique of any method of resection of the stomach. The methods of resection are numerous. Each surgeon acquires a preference for the methods which give him the best results.

For gastric resections for malignant disease of the stomach, we have found the Polya type of resection to be the most useful. When it is necessary to remove practically the entire lesser curvature, Finsterer's modification of the Polya type operation has proved to be most advantageous. In bad risk patients, a blood transfusion is always given immediately at the end of the operation. It is more advantageous at this time than when given preoperatively or late after operation.

The mortality rate of partial gastrectomy for cancer of the stomach varies greatly in different clinics. Balfour's record of 200 gastric resections for cancer of the stomach with only 10 deaths in the hospital, a mortality rate of 5 per cent, is quite remarkable. It is not likely that many surgeons will duplicate this record. Even though in the hands of the average surgeon, we must expect a considerably higher operative death rate; however, surgery should not be withheld from any cancer case in which there is a possibility of a cure for without operation, the mortality is inevitably 100 per cent.

GASTRIC AND DUODENAL ULCERS

While it cannot be claimed that we have a full understanding of the causes of ulcer, we do know that certain factors contribute to its onset and persistence. There is abundant evidence that two important factors in the production of ulcer are: infection with local trauma to the mucous membrane, and the corrosive and irritative qualities of the gastric juice. Most observers agree that the most common factor in chronic peptic ulcer is hyperchlorhydria, and the treatment, whether medical or surgical, is based on this fact, and the success of treatment depends largely upon how completely the hyperchlorhydria can be permanently controlled.

Ulcers of the stomach and duodenum are essentially a condition requiring treatment on medical lines. There is little doubt that in the majority of cases, acute peptic ulcers can be cured or at least adequately controlled by medical measures, the general principles of which are quite well standardized. The patient with chronic gastric or duodenal ulcer, who fails to respond to medical methods of treatment, which produces symptoms interfering with the patient's work or other activities, should be treated surgically. One cannot standardize the surgical procedure for either gastric or duodenal ulcer. Different types of lesions in different individuals require different surgical procedures.

Whatever be the significance of infection as a primary factor in the cause of ulcer, no treatment, either medical or surgical, is complete that does not attempt to locate and eradicate all local foci of infection. No operation for peptic ulcer is complete which does not include a search for other foci of infection in the abdomen. The appendix is often diseased and should be routinely removed in all but aged patients. Failure to remove an infected gallbladder or appendix, or both, will tend to leave the patient with residual symptoms, and predispose to recurrence of the ulcer.

GASTRIC ULCERS

In the treatment of gastric ulcers, the relation between gastric ulcer and cancer must be considered. The relation of gastric ulcer to gastric cancer is a question upon which authorities of equal eminence differ greatly. There can be no doubt in the mind of one who has taken a careful history of a large number of cases of cancer of the stomach that ulcer had existed a considerable period of time in many of the cases before the development of cancer. The exact percentage of gastric ulcers which turn into cancer, or the number of cases of cancer which are superimposed upon ulcers, is unknown. Gastric ulcer and gastric cancer must be distinguished positively before medical treatment of a supposed

ulcer should be undertaken. This, however, is not always possible even with the most careful clinical and roentgenologic examinations. In any gastric case, in which there is a suspicion that the ulcer may be malignant, surgery is demanded at once. Lahey and Jordan give excellent criteria for the safe treatment of supposed gastric ulcers. They require, within a period of not more than three weeks, that the symptoms must be completely relieved, that the lesions, by repeated roentgen studies must show definite improvement and final healing, that blood must disappear from the feces and from the gastric contents.

The type of operation to be carried out in gastric ulcer cases is dependent greatly on the location of the ulcer. In most cases of chronic gastric ulcer, a partial gastrectomy is the operation of choice. Ulcers occurring on the greater curvature of the stomach are most likely to be malignant, and for this reason, a greater curvature ulcer demands a partial gastrectomy. Pyloric ulcers are less prone to become malignant and are often associated with a marked degree of pyloric stenosis. In such cases, a gastroenterostomy is indicated and will give satisfactory results. The prepyloric lesions are best treated by a partial gastrectomy.

A local excision of an ulcer in the prepyloric region is usually not a satisfactory procedure, and furthermore, these ulcers must always be viewed with a suspicion of malignancy. Large eroding ulcers on the posterior wall of the stomach do not do well following a gastroenterostomy, and local excision usually is not practical, making a partial gastrectomy the operation of choice. Lesser curvature ulcers are perhaps the least prone to malignant degeneration. The small penetrating lesser curvature ulcer may be treated by local excision of the ulcer and a gastroenterostomy. The larger ulcers, if not too high on the lesser curvature, making gastric resection impractical, should have a partial gastrectomy. In cicatricial pyloric obstruction, the result of a healed pyloric or prepyloric ulcer, an immediate gastroenterostomy is demanded, the results of which are excellent.

DUODENAL ULCERS

In the treatment of duodenal ulcers, it is important to remember that, as such ulcers never become malignant, it is only when the symptoms cannot be relieved by other means that surgery is indicated. More problems are involved in the selection of type of operation for duodenal ulcer than for the type of operation for gastric ulcer. Factors determining the operative procedures are—the location of the ulcer, the degree of pyloric obstruction present, the mobility of the duodenum, and the history of hemorrhage.

For many years gastroenterostomy has been the most popular operation for duodenal ulcer. Recently, it has become somewhat less popular, its chief drawback being the danger of the development of a gastrojejunal ulcer. In duodenal ulcer, with marked obstruction, gastroenterostomy is the operation of choice. Gastroenterostomy gives satisfactory results in older patients, and this is especially so if at least a moderate degree of obstruction exists. When a duodenal ulcer is of large size and of the penetrating type, with fixation to the surrounding tissues, so that its complete removal would be difficult, and entail a considerable risk, a gastroenterostomy is the operation of choice.

Ulcers on the anterior wall of the duodenum in cases in which the duodenum is mobile and accessible should be treated by excision of the ulcer and some form of pyloroplasty. Pyloroplasty after the method of Judd, which consists of removal of the anterior half of the pyloric sphincter, in addition to excision of the ulcer, is a safe procedure for accessible anterior ulcers, and the ultimate results are good. This operation produces the same physiological changes as occur in cases in which a gastroenterostomy is performed. Gastric acidity is reduced, and in the absence of the action

of the pyloric sphincter, there can be no pylorospasm, and there is an opportunity for the duodenal contents to flow into the stomach, accomplishing its neutralizing effect as happens after a gastroenterostomy.

Recurring hemorrhage in duodenal ulcer, with intervals of almost complete freedom of symptoms for varying periods, is a definite indication for operation. In these cases, some form of radical surgery should be considered, because a gastroenterostomy does not protect against further hemorrhages, and the situation of the ulcer is usually such that a simple excision and a pyloroplasty would be a dangerous technical procedure.

In patients in whom the duodenum can be readily mobilized, and the patient is in good condition, a partial duodenectomy combined with a gastric resection will give the most satisfactory results of any procedure.

When the ulcer is located in the posterior wall of the duodenum it is frequently so attached to the head of the pancreas, and the posterior wall of the duodenum is so adherent to the surrounding tissues, that a duodenectomy is an extremely difficult procedure. In such instances, instead of making a duodenectomy and gastric resection, a Devine operation, supplemented by a partial gastrectomy, is a satisfactory and a safer procedure. In this procedure, the stomach is divided above the incisura and the lower segment closed after the method of Devine. A portion of the proximal segment of the stomach, extending to a point just beyond the center of the stomach, is now removed, and the operation is completed by making a posterior Polya anastomosis. Removing the central portion of the stomach, in addition to the Devine operation, tends to prevent the development of jejunal ulceration by lessening the amount of gastric secretion diverted into the jejunum. Duodenal ulcers, when completely excluded from all gastric secretions, are almost certain to heal and remain healed. Recently in two cases of posterior duodenal ulcer, in addition to carrying out the above procedure, we have followed Bancroft's suggestion of removing the entire mucous lining from the distal portion of the stomach before closing that segment. The results have been excellent in both cases.

SURGERY OF BLEEDING ULCER

The problem of the bleeding ulcer is one of undoubted difficulty. A duodenal ulcer with hemorrhage repeating itself until the patient is exsanguinated presents a real problem for a surgical decision. Whether and when active surgical intervention should replace expectant treatment is a question to which no dogmatic answer can be given. While bleeding from a peptic ulcer is seldom fatal, fatalities do occur. For controlling hemorrhage from a duodenal ulcer, rest is the most important measure. This can best be accomplished by the use of morphine, giving nothing by mouth, and keeping the stomach free from gas and gastric secretion by passing a Jute tube through the nose into the stomach, which is left in place several days. In the extreme case, blood transfusion should be used.

If, as seldom happens, the hemorrhage repeats itself, to the degree of danger of a fatality a direct surgical attack on the ulcer should be seriously considered. One should remember that these patients are too sick to stand any radical surgical procedure, and as little surgery as possible should be done. A massive blood transfusion should be given, followed immediately by a laparotomy. The duodenum should be opened freely, giving good exposure of the ulcer. The bleeding can best be controlled by transfixion of the vessel by the Lahey criss-cross suture.* In closing the duodenum, it is well to suture in a manner that will obstruct the pylorus, and then complete the operation by making a posterior gastroenterostomy.

* Lahey, F. H. Selection of operative procedure for various gastric and duodenal lesions. *S. Clin. North America*, 1933, *13*, 541–559.

ACUTE PERFORATED GASTRIC AND DUODENAL ULCERS

A perforated ulcer is always a serious lesion and becomes a real surgical emergency. Any radical surgical procedure is contraindicated. Our efforts should be directed towards saving the patient's life rather than making any direct attempt to cure the ulcer. An early diagnosis is of prime importance as the prognosis is good if the perforation can be closed within eight hours after it has happened. The mortality rate rises rapidly with each elapsed hour after this period. With a perforation of an ulcer there is practically always an escape of gas into the free peritoneal cavity. The gas has a tendency to ascend upwards beneath the diaphragm. In doubtful cases, a flat roentgenogram should be made and if a gas bubble can be demonstrated, an immediate operation is indicated. The operation should consist of simple closure of the ulcer, and a gastroenterostomy added only in those cases in which closure of the ulcer has resulted in an obstruction of the pylorus. It has been our practice always to place drainage in each flank by bringing a cigarette drain out through a stab wound in the flank. A considerable amount of gastric fluid will be found to have gravitated into the pelvis which should be drained by placing a drain in the cul-de-sac through a suprapubic stab wound.

Vol. XXXII, No. 2

PELLEGRINI-STIEDA'S DISEASE*

(POST-TRAUMATIC CALCIFICATION OF THE COLLATERAL TIBIAL LIGAMENT OF THE KNEE)

By MAX RITVO, M.D., *Visiting Roentgenologist, and*
JOSEPH RESNIK, M.D., *Physician-in-Chief, Department of Physical Therapeutics*
Boston City Hospital
BOSTON, MASSACHUSETTS

INTRODUCTION

PELLEGRINI-STIEDA'S disease is a post-traumatic calcium deposit in the region of the collateral tibial ligament of the knee and manifests itself in the roentgen examination as an area of calcification lying in the soft tissues medial to the inner condyle of the femur. The shadow of the calcified mass does not become visible on the roentgenogram until two weeks or more after the injury. It is therefore necessary to make repeated roentgen studies to establish the diagnosis.

Pellegrini[8] published the first case of this disease in 1905 and in 1908 Stieda[11] made an apparently independent record of a similar case. Numerous reports of this condition have since appeared in the European literature. It was not till 1933 that a case of Pellegrini-Stieda's disease was reported in the American literature,[7] although an editorial[3] in the AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY in the issue of July, 1932, discussed this subject. This editorial and Kulowski's paper[7] stimulated our interest and we have since that time collected 11 cases of this malady. Some of these had been diagnosed incorrectly previously and it was only after a careful review of the history and the roentgenograms that the correct diagnosis was made.

ETIOLOGY

Pellegrini-Stieda's disease is always post-traumatic. The injury may be severe or slight and may be a direct blow to the knee or an indirect trauma such as tripping or falling. Some authors state that the disease may result from repeated, slight injuries. In no case has Pellegrini-Stieda's disease occurred spontaneously, as the result of infection, or in conjunction with a neoplasm of the knee. In our series, all the cases except one occurred in males, probably due to the fact that men are more liable to trauma of the knee. All of our patients were adults.

PATHOLOGY

Pellegrini-Stieda's disease is a deposition of calcium in the soft tissues overlying the medial condyle of the femur. The calcification is in the collateral tibial ligament. This ligament is a flat band applied to the medial side of the knee joint; it arises from the inner epicondyle of the femur distal to the adductor tubercle and passes downward attaching to the medial condyle and medial portion of the shaft of the tibia below the level of the tuberosity. Pellegrini in his original paper[8] reported that the calcification occupied the central part of the collateral tibial ligament for about two-thirds of its length. In his opinion, the calcification was due to a metaplasia of tendon tissue to bone tissue, for any connective tissue may under special conditions be transformed into bone. Calcification in soft tissues occurs in parts which are dead or in a condition of reduced vitality as a result of abnormal processes such as inflammation, trauma, tuberculosis, etc. These deposits have been found in muscle, tendon, bursa, pleura, pericardium, scalp, glands, and many other body structures. Many theories have been advanced to explain these calcifications. The explanation of Klotz[6] as to the reason for the formation of pathological deposits appears to be the

* Read before the American Congress of Radiology, Chicago, Ill., Sept. 25–30, 1933.

correct one. He believes that the trauma so lowers the vitality of the cells that they are unable to utilize the products brought to them by the blood. The normal metabolism is therefore disturbed with the result that the soluble calcium compounds in the blood and lymph are replaced by insoluble ones. As this change goes on slowly, it is not till about two or three weeks after the injury that sufficient insoluble salts have been precipitated to make the shadow visible on the roentgenogram (see Figs. 4 and 5).

Stieda[11] maintains that the shadow is a fracture of the medial condyle of the femur, resulting from a tearing away of the gastrocnemius muscle. However, roentgen studies immediately after the injury show no evidence of fracture or any abnormal areas of calcification in the soft tissues about the knee. As stated above, it is two weeks or more after the injury until the calcified mass becomes visible on the roentgenogram, proving that we are dealing with a post-traumatic calcification rather than a fracture. Some authors[8] have felt that the shadow is due to periosteal proliferation at the site of attachment of the ligaments and tendons. Many competent anatomists and pathologists are of the belief[5] that the periosteum has no osteogenic functions. Kulowski[7] and others are of the opinion that this condition is similar to myositis ossificans. This theory is corroborated by the fact that the calcified mass of Pellegrini-Stieda's disease may recur after operative removal as is often the case with myositis ossificans.

Microscopically, the calcified mass of this disease is definitely bony in character and infiltrates the tendons and ligaments overlying the medial aspect of the knee. Petrignani[10] found laceration of the ligament, followed first by infiltrated hemorrhage and then ossification. In the case of Kulowski, there is no involvement of the internal ligaments of the knee and the calcified body lies entirely in the soft tissues with no connection to the bone or periosteum of the femur. The bony mass is composed of three types of bone growth: (1) primitive bone on the basis of connective tissue, (2) callus-like bone and (3) enchondral variety of cartilage ossification.

The chemical composition of the deposit in Pellegrini-Stieda's disease is similar to that found in normal bone, about 15 per cent calcium carbonate and 85 per cent calcium phosphate. Wells[12] and others have shown that the composition of calcified masses as regards inorganic salts is practically the same whether the salts are laid down under (so-called) normal conditions, as in the healing of fractures, or under pathological conditions.

SIGNS AND SYMPTOMS

In the period directly following the injury, the symptoms are those associated with trauma to the knee, namely, pain, swelling, tenderness, and limitation of motion. The severity and character of these findings vary with the nature of the injury. The pain and disability persist longer than would be expected with the trauma received, and it is this failure of the symptoms to subside in the usual time which leads to further roentgen studies after an interval of several weeks or months. In cases seen months or years after the onset of the disease, the patient may complain of limitation of motion of the knee joint. There is a sense of resistance and thickening in the soft tissues of the inner aspect of the knee. The calcified mass may be palpable; it is hard, usually slightly movable, and is not attached to the skin overlying it. There is no tenderness on pressure over the calcified mass in the late stages of the disease.

ROENTGEN FINDINGS

The roentgen examination in the typical case of Pellegrini-Stieda's disease (see Fig. 1) reveals a semilunar-shaped area of calcification in the soft tissues just medial to the inner condyle of the femur. The shadow is usually crescentic and forms a sort of cap-like covering to the femoral condyle; it may however be elongated, rounded, or triangular in shape. The dimensions of the calcified shadow are variable. The length

varies from 0.5 cm. to 8.0 cm. and the thickness from 2 mm. to 1.5 cm. As the disease progresses, the shadow usually enlarges in all diameters.

The density of the calcified area changes with the age and size of the shadow. Recently formed masses cast a slight shadow, sometimes so faint as to be barely visible (see Fig. 5). After the lapse of a few weeks, it becomes increasingly opaque and when it is of months' or years' standing, the calcified area (see Fig. 3) becomes as dense as the bone of the femur. The shadow is usually of uniform density throughout its entire extent. The borders of the calcified mass are in most instances sharply defined and smooth in outline; at times, especially in shadows of many months' or years' duration, the borders are irregular, serrated, and poorly defined.

The typical shadow in Pellegrini-Stieda's disease is entirely free in the soft tissues overlying the medial condyle of the femur and there is an area of radiance between the femur and the shadow. This is of great importance in ruling out the possibility of osteoma, periostitis or fracture of the femoral condyle as the cause of the abnormal shadow. There may be a fracture, periosteal tear, or similar condition in conjunction with Pellegrini-Stieda's disease. In rare instances, there appears to be a zone of calcification connecting the shadow in the soft tissues with the femoral condyle; this may be apparent, rather than real, and be caused by the angle at which the roentgenograms were taken. The soft tissues about the area of calcification are thickened and denser than normal.

Fig. 1. Case 1. Pellegrini-Stieda's disease, showing the typical area of calcification in the soft tissues overlying the medial condyle of the femur.

Fig. 2. Case 11. Roentgen examination two days after injury to knee, showing no calcification in the soft tissues (see Fig. 3).

The calcified shadow of Pellegrini-Stieda's disease does not make its appearance until about three weeks after the trauma to the knee, although it has been reported as early as fifteen days. If the patient is examined soon after the injury, there is swelling and thickening of the soft tissues about the inner aspect of the knee, but no other demonstrable abnormality (see Fig. 4). Many patients are thereupon considered as presenting merely a strain

Fig. 3. Case II. Pellegrini-Stieda's disease of long standing. Same patient as in Figure 2, about three years later. Notice the large, irregular area of calcification which is now present in the soft tissues overlying the inner femoral condyle.

or sprain and the correct diagnosis therefore overlooked. If the possibility of Pellegrini-Stieda's disease is borne in mind, the patient is advised to return in two or three weeks at which time a faint, thin area of density is visualized in the soft tissues (see Fig. 5). Subsequent examinations reveal the typical findings described above.

Anteroposterior roentgenograms demonstrate the shadow best. It is essential that the view be in the true anteroposterior plane. In the oblique position the calcified area may appear to be attached to the femur because of overlapping. In the lateral projection the shadow is usually obscured by the femur.

TREATMENT

In the early or acute stages of Pellegrini-Stieda's disease, the ideal treatment is rest and physiotherapeutic measures. We were led to believe that physiotherapy would be of value in the treatment of this condition because of the resemblance of Pellegrini-Stieda's disease to subdeltoid bursitis. In these maladies, there is an area of calcification in the soft tissues; the shadow is near a joint and the symptoms are similar in both instances. Subdeltoid bursitis is cleared up clinically and roentgenologically by physiotherapy.[4] The results are more satisfactory in recent calcifications than in calcified bursae of long standing. Physiotherapy appears to convert the insoluble calcium deposits into soluble salts which are then removed, with disappearance of the calcified shadow and relief of symptoms. The earlier in the disease treatment is instituted, the more soluble the lime salts appear to be,[2] hence the more rapidly cure is obtained.

Fig. 4. Case III. Film taken four days after injury to knee. There is soft tissue swelling over the inner aspect of the knee, but no evidence of any other abnormality.

Working from this analogy, we instituted physiotherapy in a case of Pellegrini-Stieda's disease.

The patient, Mrs. S. C., aged thirty-eight, received a blow on the left knee on March 4, 1933, being thrown against the emergency brake of the car in which she was riding. The injury did not seem to be of sufficient severity to demand attention at first. On April 23, 1933, about six weeks later, she noted pain and swelling over the medial aspect of the left knee. Rest in bed and applications of ice gave no relief. Three days later roentgen examination was made with the portable machine at the patient's bedside, which revealed a typical case of Pellegrini-Stieda's disease (see Fig. 6).

On May 1, seven weeks after the injury, physiotherapy was instituted as follows: diathermy and chlorine ionization to the left knee; radiant heat, massage, and motion to the entire lower extremity. Treatment was given daily for the first two weeks and then every other day. Within two weeks, there was practically complete relief of pain and swelling and the motions of the knee were normal. There has been no recurrence of symptoms to date and the patient can use the affected limb as well as the normal. Roentgenograms taken at intervals showed gradual, progressive diminution of the shadow with finally complete disappearance on September 6, 1933, about four months after treatment was instituted (see Figs. 7 and 8).

Fig. 5. Case III. Pellegrini-Stieda's disease. Same patient as in Figure 4, four weeks later. There is a typical, semilunar-shaped area of calcification overlying the upper portion of the medial condyle of the femur.

Fig. 6. Case IV. Mrs. S. C. Pellegrini-Stieda's disease. About six weeks after injury to the knee, showing a calcified mass in the soft tissues medial to the inner condyle of the femur.

Three other patients of our series are under treatment with physiotherapy. These are cases with large, dense, well calcified shadows of eight months', one year's, and four years' duration respectively. All three patients complained of swelling, pain, and stiffness of the knee. After three months of treatment, there has been relief of pain, subsidence of the swelling, and increased mobility of the knee. The areas of calcification have shown no appreciable change in size in this time. We are continuing treatment for another three months and

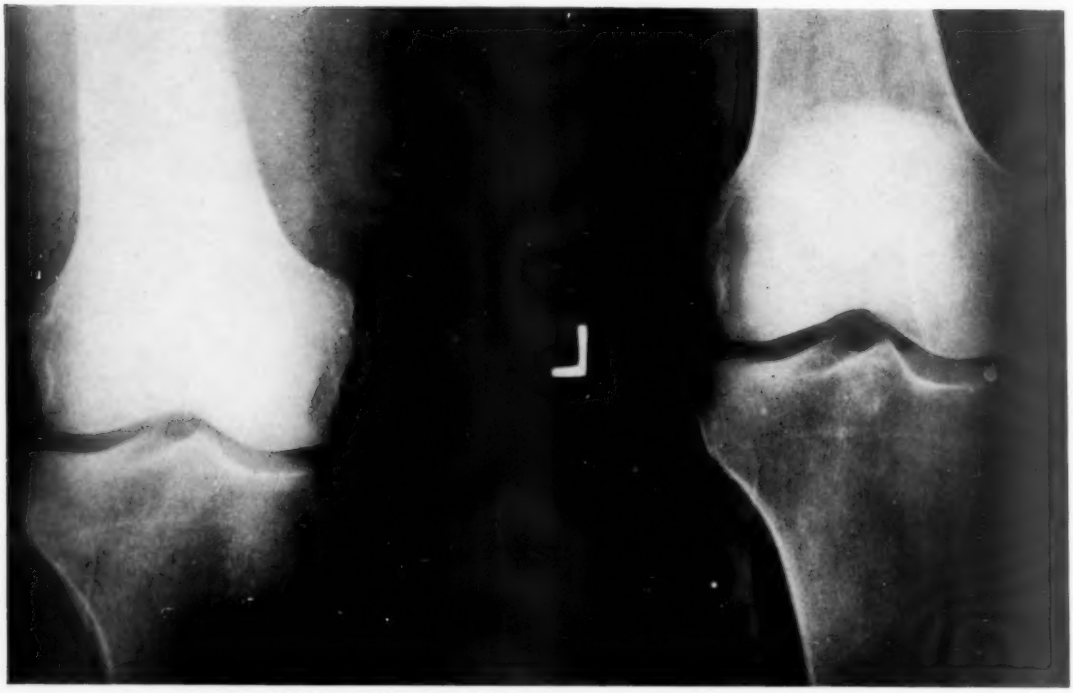


Fig. 7. Case iv. Same patient as Figure 6, one month later, after four weeks of physiotherapy and rest. The calcified mass is smaller and is irregularly mottled, indicating that it is being absorbed.

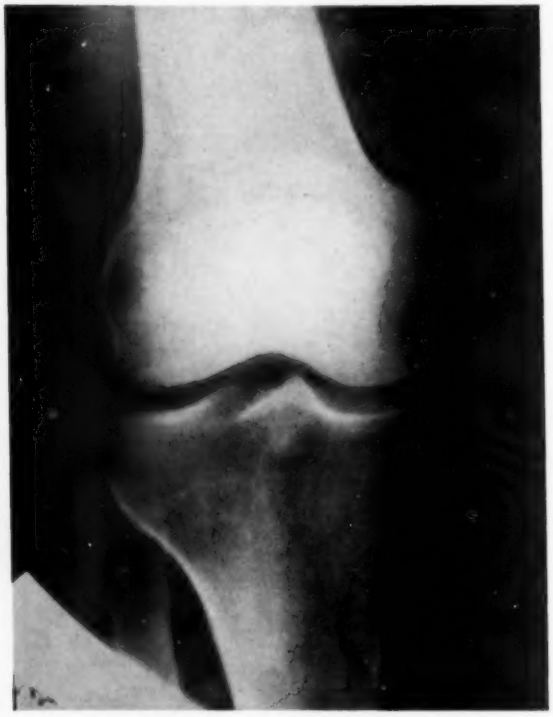


Fig. 8. Case iv. Same patient as in Figures 6 and 7, after four months of physiotherapy. The calcified mass has disappeared and patient is entirely well.

if at the end of that time the calcified masses have not disappeared, we shall probably advise surgical measures.

The rationale of the various physiotherapeutic measures cannot be stated definitely. In a general way it may be said that diathermy augments the local blood supply to deep-seated tissues, improving the metabolic activity of the affected area and thereby bringing about the absorption of the calcium deposit. Whether this is accomplished by an increase in carbon dioxide content or by the production of local acidity has not been established. The chlorine ionization may assist in the conversion of calcium carbonate and phosphate into soluble chlorides;[9] or the effect may be due to the chemical changes produced by the galvanic current itself.[1] Because of the limitation of motion of the affected knee and the tendency of the patient to favor the entire limb with resultant atrophy and loss of muscle tone, radiant heat, massage, and passive motion were used in our treatment.

We believe that the results obtained in these cases indicate the value of physiotherapeutic measures and should encourage repetition of this treatment in Pellegrini-Stieda's disease. We feel strongly that it is of the utmost importance to make the diagnosis early and institute treatment at once. The possibility of Pellegrini-Stieda's disease should be borne in mind in all injuries to the knee and the patient should be studied with the roentgen ray a few weeks after the injury and again at a later date before the diagnosis is ruled out. In cases of long standing, physiotherapy probably cannot bring about a complete cure although it does appear to be distinctly beneficial. In late cases, surgery is probably the method of choice. However, early surgery is contraindicated, as proved by the case of Kulowski in which the calcification recurred after operation.

SUMMARY AND CONCLUSIONS

Pellegrini-Stieda's disease is a post-traumatic calcification of the collateral tibial ligament of the knee. The calcification manifests itself in the roentgen examination as an area of density in the soft tissues overlying the medial condyle of the femur.

This shadow does not become visible on the roentgenogram until about three weeks after the injury to the knee. Therefore this condition is frequently overlooked and it will continue to be overlooked unless it is borne in mind in all injuries to the knee and repeated roentgen studies made.

Since Pellegrini's original paper in 1905, a great many cases have been recorded in the European literature, but only one case is on record to date in the American literature. We have collected eleven cases of this malady in our practice, some of which had been diagnosed incorrectly previously.

This condition may result from a severe or slight trauma; it is more common in males, and all the patients in our series were adults.

Pellegrini-Stieda's disease is a true post-traumatic calcification, and is not due to a fracture, periostitis, or neoplasm. The calcified mass lies entirely free in the soft tissues and is not connected to the bone or periosteum of the femur.

The symptoms consist of pain, swelling over the inner aspect of the knee, and limitation of motion of the knee.

In the roentgen examination, there is a rounded or semilunar-shaped area of calcification in the soft tissues overlying the internal condyle of the femur. This shadow is seen in the anteroposterior and oblique projections, but is usually obscured by the overlying femur in the lateral views.

The treatment in the acute stages is rest and physiotherapeutic measures, consisting of diathermy, chlorine ionization, radiant heat, massage, and motion. Under this treatment, there is relief of all symptoms and, in recent cases, disappearance of the calcified mass.

REFERENCES

1. Cumberbatch, E. P. Essentials of Medical Electricity. Sixth edition. C. V. Mosby Co., St. Louis, 1929.
2. Durham, R. H. Scleroderma and calcinosis. *Arch int. Med.*, 1928, *42*, 467–490.
3. Editorial. Pellegrini-Stieda's disease. Am. J. Roentgenol. & Rad. Therapy, 1932, *28*, 97.
4. Granger, F. B., and Resnik, J. Calcified subdeltoid bursitis treated by physiotherapy. *Boston M. & S. J.*, 1927, *197*, 188–190.
5. Greig, D. M. Clinical Observations on the Surgical Pathology of Bone. Oliver and Boyd, Edinburgh, 1931.
6. Klotz, Oskar. Studies upon calcareous degeneration. I. The process of pathological calcification. *J. Exper. M.*, 1905, *7*, 633–675.
7. Kulowski, J. Pellegrini-Stieda's disease. *J. Am. M. Ass.*, 1933, *100*, 1014–1017.
8. Pellegrini, A. Traumatic calcification of the collateral tibial ligament of the left knee joint. *Clin. mod.*, 1905, *11*, 433–439.
9. Peters, J. P., and Van Slyke, D. D. Quantitative Clinical Chemistry. Williams and Wilkins Co., Baltimore, 1931.
10. Petrignani, R. Contribution to the Study of Pellegrini-Stieda's Disease. Thèse de Paris, 1930.
11. Stieda, A. Ueber eine typische Verletzung am unteren Femurende. *Arch. f. klin. Chir.*, 1908, *85*, 815–826.
12. Wells, H. G. Chemical Pathology. Fourth edition. W. B. Saunders, Philadelphia, 1920.

A SUPERNUMERARY RIB ARISING FROM THE SECOND LUMBAR VERTEBRA

By BERNARD H. NICHOLS, M.D., *and* E. LEE SHIFLETT, M.D.
Cleveland Clinic
CLEVELAND, OHIO

TEXTBOOKS on anatomy and embryology describe costal elements associated with the transverse processes of the first lumbar vertebra which may develop into accessory ribs. This accounts for the supernumerary ribs frequently observed at this site in routine roentgenographic examinations of the spine. We do not find a description of a similar developmental procedure involving the remaining lumbar vertebrae. We have recently observed an accessory rib articulating with the transverse process of the *second* lumbar vertebra. This is the only instance of its kind which has been encountered in the roentgenographic examination of many thousands of lumbar spines. The placing on record of such an interesting anomaly seems justified.

FIG. 1. Roentgenogram of cervical spine.

Roentgenograms of the entire spine and of all the ribs were made in order to study the morphology and to establish the total number of vertebrae and ribs, and to determine if other anomalies were present. But all of these structures appeared normal in every respect.

Since the rib-bearing vertebra is preceded by an apparently normal first lumbar vertebra, and is followed by three normal lumbar vertebrae, and the usual number of vertebrae and ribs are present, it seems that this is a lumbar rib associated with a *second* lumbar transverse process.

CASE REPORT

The patient was a woman, aged sixty, whose chief complaint was "indigestion for many years." This was chiefly a matter of fullness, eructations, constipation, and fleeting pains in the lower part of the abdomen. There was no history of injury.

The patient was somewhat pale and anemic. She had occasional extrasystoles and her radial vessels were moderately sclerotic. The blood pressure was 166 systolic, 112 diastolic. Her posture was good as were all spinal movements, but on hyperextension there was pain which was referred to the level of the second lumbar spinous process and there was tenderness at this point. The teeth were in good condition except that one first molar was pulpless. Urine was negative except for 20 pus cells per high power field in the voided specimen. Gastric analysis showed no free acid. Examination of the feces was negative except for much mucus. Roentgenographic examination of the colon showed normal findings. The roentgenogram of the spine showed no deviation from the normal, except for a supernumerary rib articulating with the second lumbar vertebra.

Fig. 2. Roentgenogram of dorsal spine.

Fig. 3. Roentgenogram of lumbar spine.

SUMMARY

A supernumerary rib associated with the *second* lumbar transverse process is recorded. The roentgenographic appearance of this is identical with that of a first lumbar rib which is known to be associated with an occasional independent costal element in connection with the transverse process of the first lumbar vertebra. The vertebrae and other ribs appear normal in every respect. We do not know how to explain this anomaly unless we assume that it is associated with a persistent costal element on the transverse process of the second lumbar vertebra.

The case has no clinical significance but may be of interest to anatomists and biologists.

IS IT EMPYEMA OR COLLAPSED LUNG?*

By EPHRAIM KOROL, M.D.
Veterans' Administration
LINCOLN, NEBRASKA

EMPYEMA developing during an acute respiratory illness is generally easy of recognition. With the pleural cavity presumably free of adhesions and the mediastinum normally movable, the fluid, by force of gravity, accumulates in the dependent regions of the pleural cavity, and the mediastinum moves away from the diseased side. The typical signs of pleural effusion are then manifested: absence of resonance and of breath sounds over the base of one lung and the presence of a dense roentgen shadow over the corresponding area, the shadow having the characteristic concave upper border, the Damoiseau line, and the heart is displaced toward the healthy side.

Conditions are quite different in empyema occurring during the course of a chronic lung disease. Here the lung is generally contracted by fibrosis or atelectasis and the pleural cavity is chambered by adhesions. Fluid, if present, cannot drain into the complemental space, and the mediastinum cannot be displaced either because of adhesions or because of the low intrathoracic pressure on the diseased side, caused by the shrunken lung. Furthermore, the physical and roentgen signs produced by the atelectatic lung are quite the same as those given by fluid in the chest, while the Damoiseau line is absent over encapsulated effusions. (This line depends on fluid in a free pleural cavity where there are no adhesions to prevent the retraction of the lung toward the hilus.)

Chronic lung diseases are frequently accompanied by exacerbations of fever, pains in chest, increased cough and leucocytosis. Empyema or lung abscess is often suspected. The suspicion may not be allayed even after repeated dry taps, and even after exploratory thoracotomy. On the other hand, the finding of pus by paracentesis may be equivocal under these conditions.

CASE 1. Farmer, aged thirty-four. First examined in December, 1928, the diagnosis being bronchiectasis, left lung, acute exacerbation. The man was treated in the tuberculosis section of the Edward Hines Junior Hospital for three months and was sent home much improved. He returned to the hospital in June, 1929, following an attack of "flu." There was a continued type of fever varying between 100° and 103° F., pains in left side of chest, cough with expectoration of foul smelling stringy pus, leucocytosis, 24,000 with 92 per cent polymorphonuclear cells. There was dullness over the left side below the level of first rib and spine of scapula, with breath sounds suppressed and obscured by coarse moist râles; there was clubbing of the fingers. The roentgenograms showed the left lung uniformly opaque below the first interspace on the left side. The heart and trachea were displaced to the left. The fever had been present for three weeks before readmission to the hospital. A needle was inserted in the sixth interspace in the left anterior axillary line. At a certain depth a cavity was entered; the patient immediately coughed and the 2 c.c. syringe filled with a ropy gray material. The syringe was emptied and reapplied, but now air was drawn, no pus. The operation was repeated in the eighth interspace posteriorly with the same results; the needle was felt to enter a cavity, the man strained to cough and the syringe filled with pus; further aspiration drew air. After consultation with the surgeon (a chest surgeon of international reputation), it seemed clear that we were dealing with a neglected empyema, and immediate drainage was undertaken. On the operating table aspiration with a needle again brought granular pus which squirted into the syringe in a small stream. Upon thoracotomy the lung was found adherent, a cavity was laid open which was recognized as a dilated bronchus. Another incision was made over the ninth rib posteriorly, with

* Published with the permission of the Medical Director of the Veterans' Administration who is not responsible for the ideas expressed or the conclusions drawn in this paper.

exactly the same results. No large cavity was located. The wounds were left open and it was hoped that drainage would follow. This did not materialize, however.

Post-mortem examination showed the left lung adherent throughout. There was no empyema. The lung was contracted and solid, crepitation in the apex only. In the upper portion of the lower lobe there was an area of softening, discolored greenish-black. There were dilated bronchi containing pus in the upper and lower lobe. Sections of the lung sank in water.

Summary. A case of bronchiectasis which during an acute exacerbation showed a symptom-complex indistinguishable from empyema. The absence of breath sounds and the percussion dullness, as well as the roentgen shadow were due to extensive atelectasis. Pus was aspirated repeatedly, nevertheless there was no empyema.

Should there be physical and roentgen findings of airlessness of one base and the heart be pushed over to the better side, the presumption of a pleural exudate is generally justified. However, the cardiac displacement may be only apparent and may be simulated by pericardial effusion. Roentgenograms taken in expiration or with the tube improperly centered may be misleading.

Case II. Colored male, aged forty, laborer. Has complained of pains in the chest, loss of weight, and cough for six months. He would have attacks of fever lasting eight or ten days; these would be relieved by the appearance of pus in the sputum. There were six such febrile exacerbations while under observation in the Edward Hines Junior Hospital from December, 1926, to September, 1927. The physical findings did not vary appreciably and consisted of a contracted left chest with flatness and absent breath sounds below the 5th rib and 6th dorsal vertebra. The roentgenogram showed the left base airless; between the 6th and 9th posterior ribs a mass with a convex outer border was dimly seen in apparent relation to the aorta; the heart was displaced to the right. Aneurysm was suspected but no pulsations could be made out roentgenoscopically. The

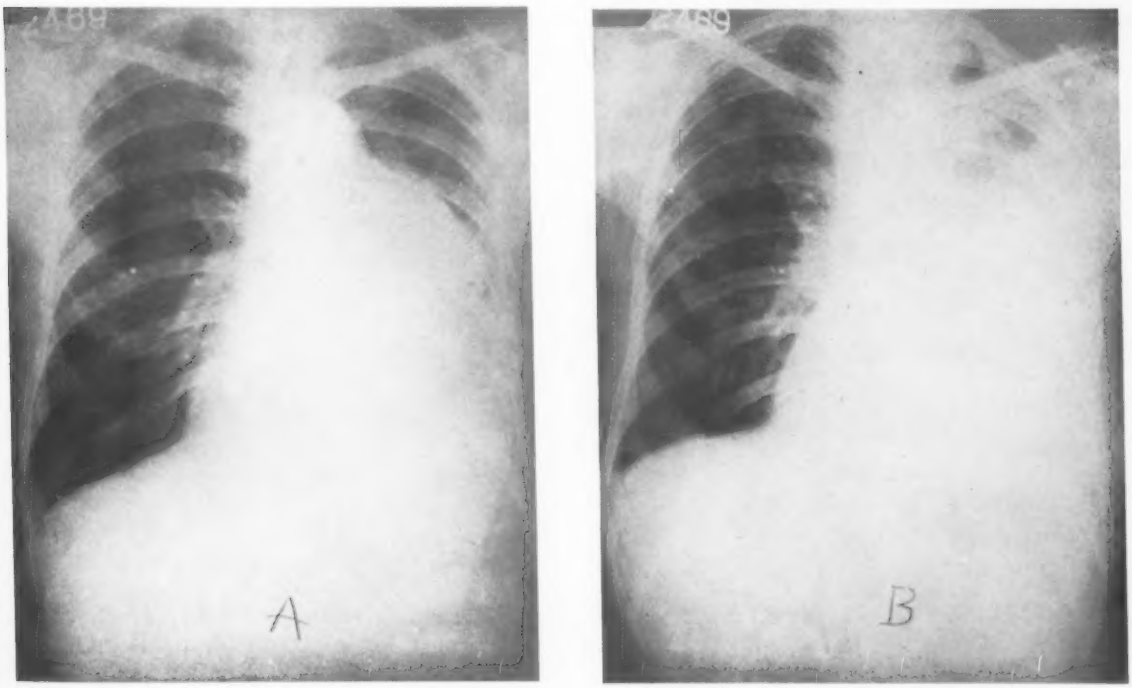


Fig. 1. Case II. A. Taken during an afebrile period. Dense shadow at left base and apparent displacement of heart to the right led to diagnosis of empyema. B. Taken during febrile exacerbation. Increased airlessness of the lung. Note further contraction of chest wall both at base and apex. Trachea displaced to the left; the heart has also moved to the left. See text for autopsy findings.

blood Wassermann reaction was negative; the Kahn test was positive 50 per cent. During two of the febrile attacks attempts were made to aspirate pus from the left lung or pleural cavity, with negative results. During the third exacerbation an abscess appeared on the chest wall in the 5th interspace in the left axilla. It drained out promptly upon incision and the wound healed. During a subsequent period of fever and suppression of sputum there was noted an increase in the roentgen shadow of airlessness, and the likelihood of encysted empyema seemed greater than ever. An exploratory thoracotomy was undertaken. A section of the 8th rib was removed below the left scapula. The lung was adherent. The chest was explored with the finger; no abscesses were found. A needle was inserted in several directions. At one point there was a sudden gush of blood under sufficient pressure to displace the barrel out of the syringe. The operation was promptly discontinued.

The man died following a sudden hemorrhage from the stomach. The post-mortem examination showed an aneurysm of the descending arch which had eroded into the esophagus. The left main bronchus was compressed and the lung was airless. The secondary bronchi were dilated and contained pus and fresh blood. The source of the pectoral abscess could not be determined. A pericardial effusion was present. Closer scrutiny of the roentgenograms showed that the heart displacement was only apparent, there actually being an enlarged heart shadow of a configuration quite typical of pericardial effusion (see Fig. 1, A and B).

Summary. A case of aneurysm of the aorta with atelectasis and bronchiectasis of left lung ran a clinical course characterized by febrile exacerbations and remissions; the physical and roentgen signs suggested pleurisy with effusion; the heart appeared displaced to the right. During each exacerbation empyema and lung abscess were suspected. During one exacerbation an abscess pointed in the chest wall. Exploratory thoracotomy was done, with negative results.

Case III. White male, aged thirty-three, farmer. Diagnosis: Abscess lower lobe of left lung following tonsillectomy. On September 24, 1932, the following observations were made: Coughs and expectorates yellow purulent material of offensive odor. The left chest is retracted posteriorly; dullness below 6th dorsal spine and in lower axilla; absent vesicular breath sounds, and coarse moist râles below 8th dorsal spine on this side. The heart is enlarged or displaced to the left. The temperature has ranged between 99° F. and 103° F. Leucocytosis, 18,000 with 84 per cent polymorphonuclear cells.

Roentgenoscopic examination shows the left lung airless, perhaps consolidated. No abscesses

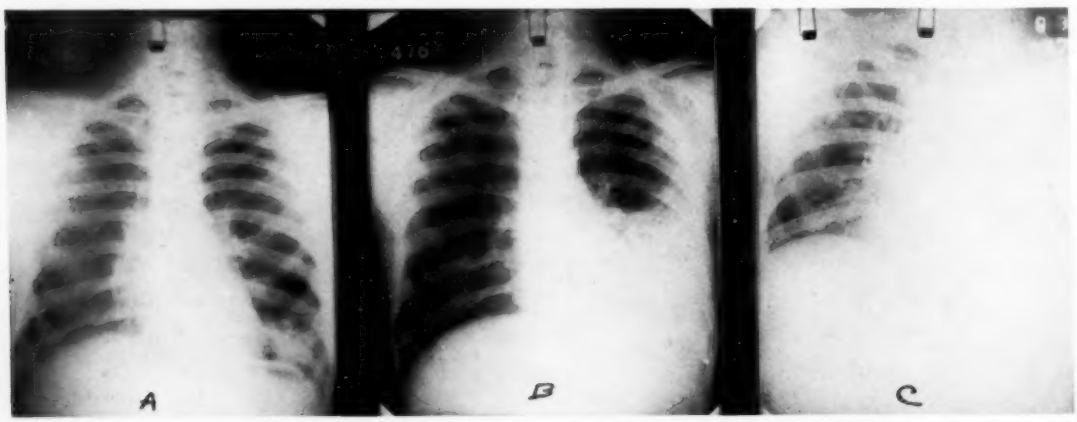


Fig. 2. Case III. A. July 1, 1932, ten days after tonsillectomy. Abscess left lower lobe. B. August 21, 1932. Increased airlessness of left base; the chest wall is contracted and the heart and trachea are displaced to the left. Distribution of lipiodol suggested pleural effusion—abrupt termination of bronchi forming a vertical line below scapula. C. August 30, 1932. Complete atelectasis of left lung. The heart appears displaced to the right. The roentgen tube was probably off center. The film was snapped in expiration (note the small right lung); this would show larger heart shadow. See autopsy report.

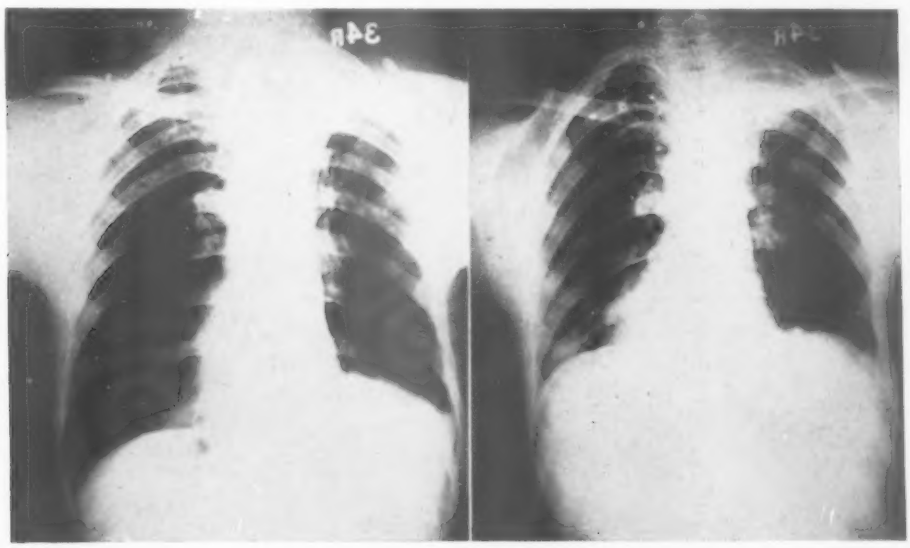
with fluid levels can be made out. The heart is displaced to the left. After injecting lipiodol into the larynx numerous dilated bronchi are visualized in left lower lobe; no circumscribed abscesses outside of the bronchi.

Diagnosis. Abscess, bronchiectatic, lower lobe of left lung. On September 30, 1932, the following note was made. There has been continued fever (102° F.) during the past week. Increasing dyspnea and weakness. Precordial pain requiring counterirritants. Pericardial rub over lower sternum. The heart tones are of good quality, the maximum intensity well inside the left mid-clavicular line. The impression is that the heart is displaced more to the right than was observed at the last examination. There is flatness, decreased fremitus, and absent breath sounds below 3rd rib and 5th dorsal vertebra. An empyema has probably developed since last examination. Acute pericarditis (see Fig. 2, A, B, and C).

Five attempts were made to locate a drainable abscess in the left side of the chest. (1) A needle was inserted in the 4th interspace in the left anterior axillary line; 2 c.c. of gray limpid fluid squirted into the syringe as the patient strained to cough. No more fluid could be obtained, only air was withdrawn. The needle was apparently in a bronchiectatic cavity. (2) In the 6th interspace in the left anterior axillary line the needle entered the lung and drained frothy serous fluid .(3) In the same interspace in the mid-axillary line blood was drawn freely, no pus. The patient coughed and raised blood. (4) In the 8th interspace in the posterior axillary line, the lung was entered, frothy serum obtained, no pus. (5) In the same interspace closer to the spine, frothy serum was withdrawn. It was decided that there was no large collection of pus in the chest. The absent resonance and breath sounds were attributed to occlusion of the bronchi by inflammatory exudate, causing areas of atelectasis and pneumonia. The post-mortem examination (October 9, 1932) showed the left lung airless. It was firmly adherent at the base to the pericardium, diaphragm, and ribs. There were three ragged intercommunicating abscesses in the lower lobe. There were two collections of pus in the left pleural cavity: one in the posterior mediastinal recess; one high in the axilla cranial to the 4th rib. Extensive fibrinous pericarditis, and 4 ounces of thin blood-tinged fluid in the pericardial cavity.

In the light of the autopsy findings, it was thought that the axillary empyema was probably present on September 30; it might have been tapped high in the axilla.

There is need for some simple method of distinguishing the atelectatic lung from fluid, in the contracted chest. In our search

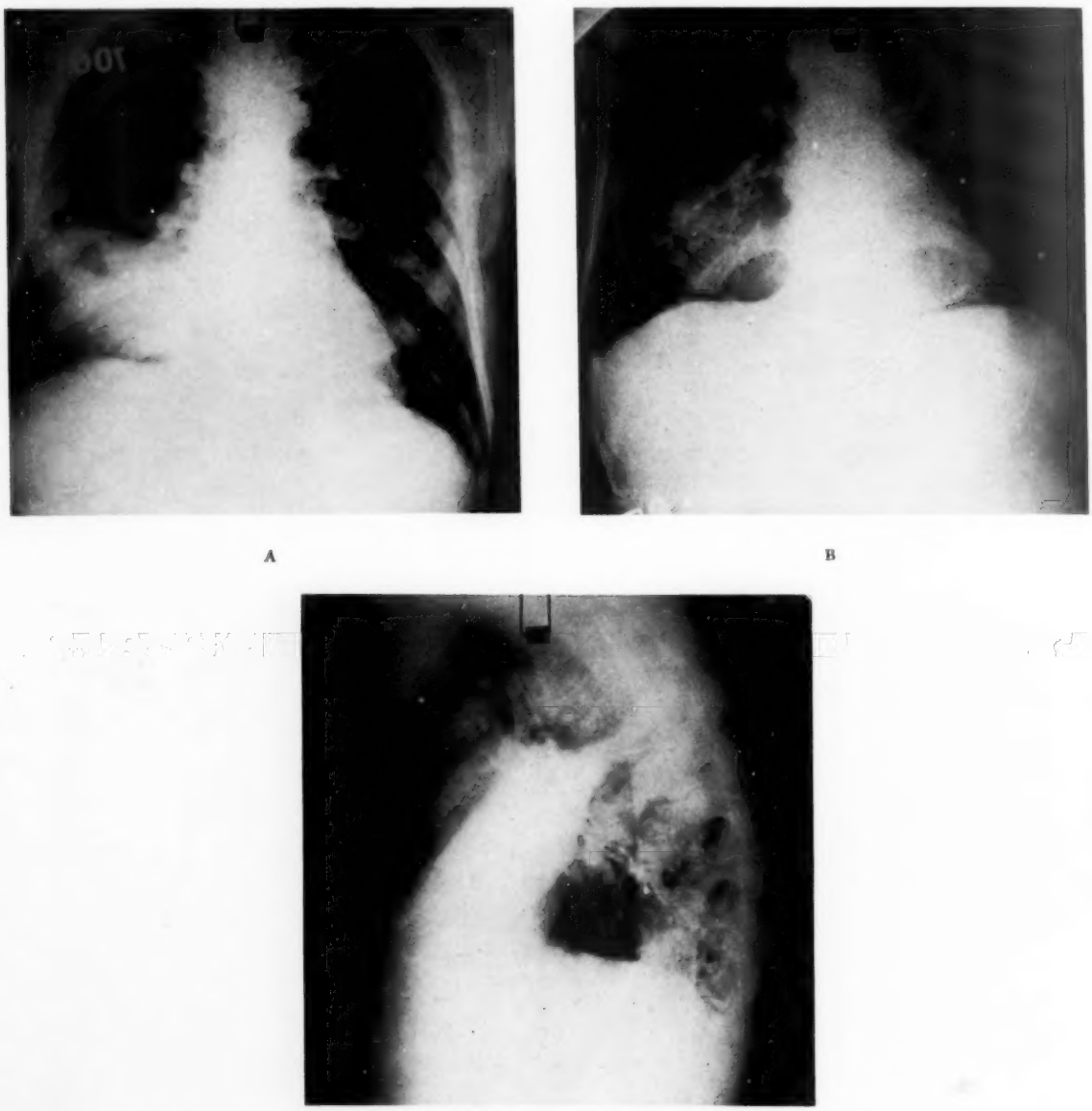


A B

Fig. 3. Dense shadow obscuring right apex. Localized effusion (?) Atelectasis (?) A. Film made in inspiration. B. Film made in expiration at same sitting as A. The atelectatic right upper lobe has been re-inflated in part. (Reproduced with permission from *Am. Rev. Tuberc.*, 1931, *24*, 284.)

for such diagnostic means, we have found the following two procedures of value:

1. In case the airless area is confined to the apical region, films are made in deep inspiration and in deep expiration. If the abnormal shadow is cast by fluid, a tumor or thickened pleura, its appearance remains unchanged in the two phases of respiration; if caused by atelectatic lung, the shadow generally enlarges and loses much of its density, i.e., the collapsed lung becomes inflated during forced expiration. The apical portion of the normal lung, as is well known, is inflated in forced expiration, and we have found this equally



A B C

Fig. 4. Case IV. A. Posteroanterior film, patient standing. The shadow at right base is caused principally by airless middle lobe. No fluid levels. B. Patient reclining on left side, film taken at same sitting as A. Increased aeration of middle lobe; the abscess cavities have also taken in air; fluid levels distinct. C. Lateral view. See text.

true of atelectatic lung in the upper half of the chest. Even though the supplying bronchi be occluded by granulation tissue or by tumor masses, to a degree sufficient to prevent normal respiration and to cause absorption of the alveolar air, *the expiratory air current generally forces enough air past the obstruction to affect the roentgen appearance* (see Fig. 3, A and B).

2. If the basal portion of the chest is involved, one roentgen exposure is made with the usual technique (in inspiration, patient erect) and a second exposure with patient reclining on the better side. If the abnormal shadow is due to airless lung, it becomes larger and less dense, due to inflation of the upper lung in this posture. Normally the apices are in relative emphysema, the bases relatively collapsed when in the erect position, largely due to the direction of the bronchi and the buoyance of the air; also in a measure because of the traction exerted on the lower ribs by their own weight and by the weight of the attached viscera. It is well to remember that in the erect position blood gravitates into the lung bases, adding to the appearance of airlessness. In lateral recumbency, the upper hemithorax is largely relieved of the weight of the viscera and undergoes enlargement; the upper lung receives more air, due to the favorable direction of the air tubes in this position; and the blood tends to drain away from the upper lung. *There results marked hyperinflation of the base of the upper lung* (see Fig. 6).

Case IV. Negro, aged forty-nine. First examined on September 17, 1931.

History. About three weeks ago the man had a toothache with much swelling of the face. Rather suddenly the swelling subsided and the pain descended into the right side of the chest. Fever appeared and he soon began to cough and expectorate foul-tasting phlegm. There was advanced pyorrhea and many teeth were missing, but the man had no knowledge of ever aspirating any of his teeth into the lungs.

Pertinent Physical Signs. Emaciation. Kyphosis and rigidity of cervical and dorsal spine. Dullness and feeble breath sounds below 4th rib on right side; area of bronchial breathing in 5th interspace in anterior axillary line. No râles. The left lung was normal. The heart was

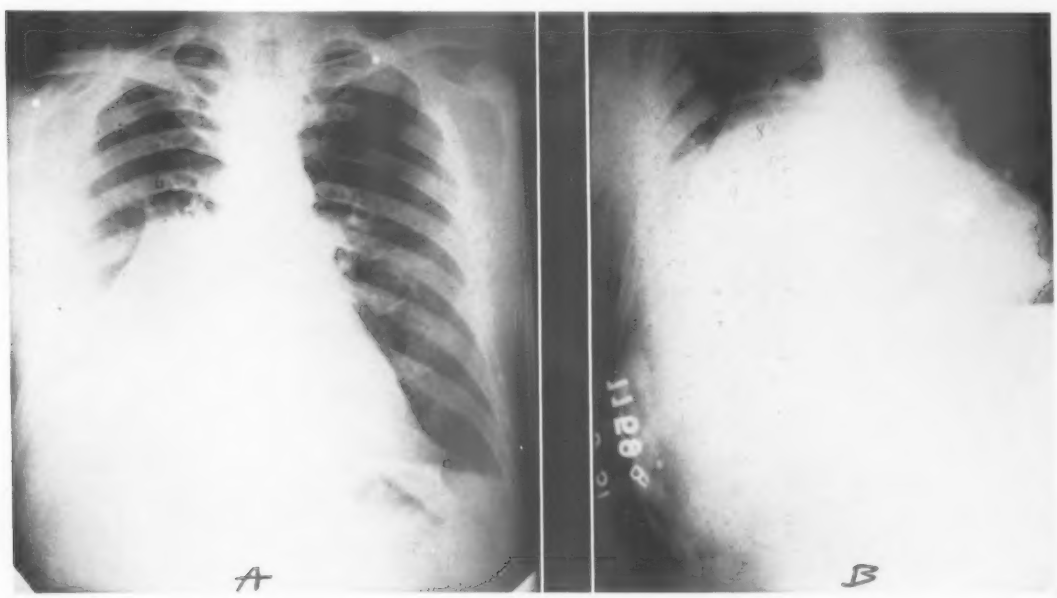


Fig. 5. Case V. Carcinoma of right bronchus causing atelectasis of right middle and lower lobes. Phrenic paralysis, right. A. Patient erect. B. Patient reclining on left side, film made at same sitting as A. Note increased air intake in middle and lower lobes (increased transparency at level of 7th and 8th posterior interspaces and in lower axilla).

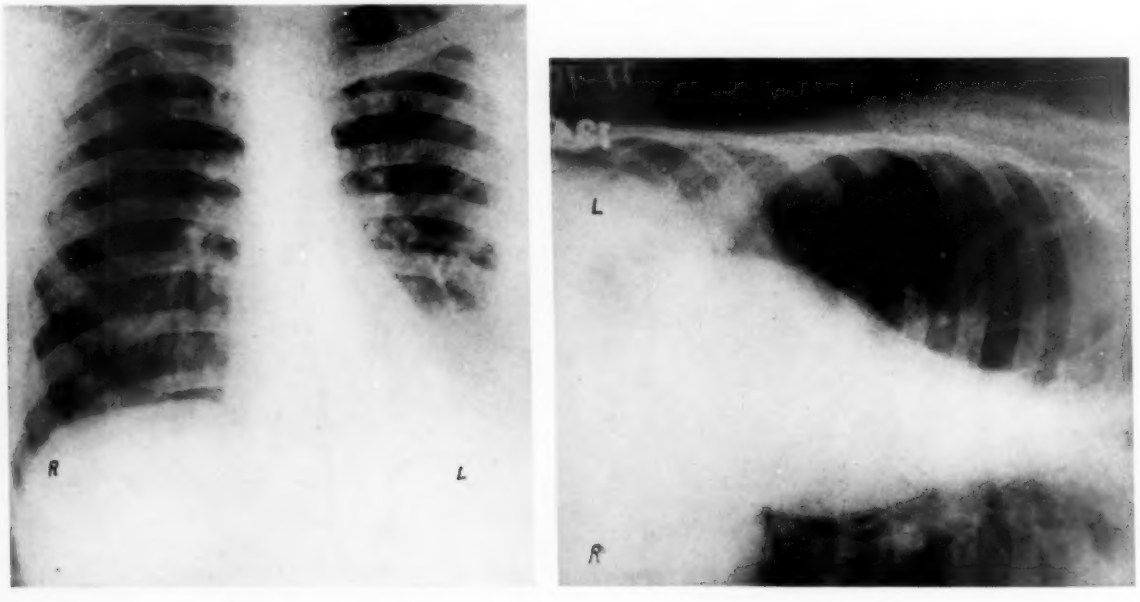
not displaced. There was a septic type of fever in spite of profuse expectoration of green pus. Leucocytosis (16,000 cells with 78 per cent polymorphonuclears). The roentgenogram, patient erect, showed an area of airlessness or consolidation in the region of the middle lobe, including an irregular area of rarefaction, without fluid level, in its upper and outer corner. There is a triangular foreign (?) body above the right hilus of unknown import. The lateral film, patient standing, revealed a dense, flask-shaped shadow with well-defined borders overlapping the heart shadow, beginning in the hilus and expanding downward and forward to the anterior attachment of the diaphragm. The shadow may be cast by an interlobar empyema, also by an atelectatic middle lobe. The film made with the patient reclining on the left side shows increased air content in the region of the middle lobe. Two distinct abscess cavities are seen, each containing fluid. The mass in the right hilus has resolved itself into two separate bodies suggesting aspirated teeth.

Paracentesis Thoracis. A needle inserted into the 4th interspace one inch inside of the right nipple produced 5 c.c. of foul smelling pus. Another entry made in the 5th interspace yielded clear serous fluid. Bronchoscopic examinations were unsatisfactory due to rigidity of the neck. The film made in lateral recumbency helped us to recognize the lung density as largely due to an airless middle lobe.

Post-mortem examination (October 28, 1931) showed the right middle lobe airless, softened in areas and discolored dirty green, and oozing a foul smelling liquid. There was also an effusion between the middle and the lower lobe.

Case v. Retired business man, aged fifty-nine. Admission diagnosis, October 6, 1931: Pleurisy, chronic, suppurative, right, with bronchial fistula.

History. In April, 1930, he was confined to bed with a chest cold for several days; a productive cough persisted and he began to lose weight. The attending physician said there was asthma and recommended a change of climate. The patient then went to Colorado and spent several months there without benefit. At Boulder, Colorado, the physician diagnosed abscess of the right lung and advised surgical collapse of the lung. Pneumothorax treatments were prevented by pleural adhesions. Phrenicotomy, right, was done in a civilian hospital, Lincoln, Nebraska, in December, 1930. There were very good immediate results following this operation; the expectoration became easier and he



A B

Fig. 6. Abnormal shadow at left base following an atypical pneumonia. Empyema (?) A. Film made with patient standing. Dense shadow at left base quite typical of pleural effusion. Diaphragm and left border of heart obscured. B. Film taken at same sitting as A, with patient lying on right side. The base of the left lung is inflated in this position. No effusion. The diaphragm and heart are well outlined.

felt better; the temperature, previously irregular, now became normal. Complaints: Weakness. Cough. Shortness of breath. Loss of 75 pounds in weight.

Physical Signs. Dyspnea on slight exertion. Diminished expansion on right side. Absent fremitus at right base; also absent resonance and no breath sounds below 4th rib and 7th dorsal spine. No râles. The heart was in the normal location. During the examination the patient coughed and raised a tenacious chocolate-colored pus. No adenopathy.

Roentgenoscopic Examination. The right lung is small. The diaphragm is high and immobile on this side. Extending from the region of the central tendon upward to the level of the 6th rib posteriorly there is a homogeneous quadrilateral dense shadow obscuring the hilus on this side. The shadow showed increased air content when the patient leaned over to the left. No nodules or distinct tumor masses. While much of the airlessness of the right lung was manifestly due to the contraction of the lung resulting from the diaphragmatic paralysis, the quadrilateral shadow in the inner portion of the lung was interpreted as an encysted empyema or an atelectatic middle lobe due to bronchial occlusion. Guided by the behavior of the shadow during changes of posture, we decided in favor of bronchial occlusion with atelectasis. The results of the bronchoscopic examination were uncertain; no foreign body or carcinoma was recognized. We felt that we were dealing with a bronchial carcinoma causing an atelectasis of the lower and middle lobes, and thought the condition inoperable. The man left the hospital unimproved.

In February, 1932, the man re-entered the civilian hospital in Lincoln, Nebraska. After a period of observation, pulmonary abscess was diagnosed and drainage with thoracoplastic collapse decided upon. Carcinoma was considered, but appeared unlikely in view of the long duration (two years) without metastasis, the sudden onset like a pneumonia, the leucocytosis, and the physical and roentgen signs of abscess or empyema, and by the relief from phrenicotomy. The 4th, 5th, and 6th ribs were partially resected in the right axilla; a cavity was located in the right lung, and tube drainage was instituted. There followed but questionable improvement.

The necropsy (March 20, 1932) disclosed a carcinoma involving the right bronchus. The lower and middle lobes were airless. There was metastasis in the mediastinum and in the left lung.

Summary. Carcinoma of bronchus producing a clinical picture so strongly suggestive of lung abscess or empyema that phrenicotomy and thoracoplastic collapse were used. The post-mortem examination showed that the physical and roentgen findings were caused not by an accumulation of fluid in the chest, but by atelectatic lung. The roentgen examination in lateral recumbency indicated airless lung rather than fluid.

SUMMARY AND CONCLUSIONS

1. Large areas of atelectasis frequently occur in chronic lung disease, producing physical and roentgen signs which are indistinguishable from those given by pleural effusions. During febrile exacerbations, empyema and lung abscess are often suspected, and the differential diagnosis may not be settled by exploring the chest with a needle, or even by exploratory thoracotomy.

2. Two diagnostic procedures are recommended. In apical conditions roentgenograms are made in inspiration and in deep expiration. If the abnormal shadow is cast by an accumulation of fluid, it remains unchanged in the two phases of respiration; if cast by atelectatic lung, the shadow enlarges and "brightens up" by taking in air during forced expiration.* If the shadow is located at the base of the lung, a film is made with the subject lying on the better side, for comparison with the film made in the erect posture. Areas of atelectasis are generally inflated in the upper lung.

* Kreutzfuch's phenomenon.

RADIATION THERAPY OF CANCER OF THE SKIN*

By G. W. GRIER, M.D.
PITTSBURGH, PENNSYLVANIA

THE treatment of cancer of the skin by irradiation is universally accepted as the treatment of choice in that condition. Likewise the use of so-called "massive dosage" is generally acknowledged to be the method of applying radiation which produces the best results. When roentgen rays are used, I think those most experienced will also agree that unfiltered radiation is preferable.

I first began using a technique answering this description in 1915. In 1921 I reported 315 cases of skin malignancy treated by this method.[5] In another contribution in 1927[6] I reported 316 more cases, and in the present article 200, a total of 831 cases. These represent only private cases. During this period I have treated quite a large number of cases in hospital practice which are not included. The technique has not been altered in any material way, so that the observations which are made are based upon something over 1,000 cases treated with practically the same technique.

When I first reported this technique in 1921, it was not received with much enthusiasm. In fact, I received many letters after its publication saying that dosages such as I employed were unnecessary and dangerous. However, by 1927 it was more or less generally employed and today I think all radiotherapists agree that the proper way to treat epithelioma is by "massive doses" of unfiltered radiation.

However, I find considerable difference of opinion as to what constitutes "massive dosage" and as I have very positive ideas on this matter, I am presenting this paper.

In a general way, the radiologist fixes a much higher limit for a massive dose than does the dermatologist. In passing, it might be interesting to note that the dermatologist appears to rely upon accessory methods of treatment much more than the radiologist, especially in squamous cell cancer. This may perhaps be explained by their different interpretation of a "massive dose."

Evans and Leucutia,[4] prominent radiologists, define a massive dose as one producing a good erythema and a hypermassive dose as more than twice that amount. They treat skin cancer with from four to seven times an erythema dose.

Eller,[3] who represents the best in American dermatology, applies what would seem to be slightly more than an erythema dose in treating basal cell epithelioma. His factors are 100 kv., 8 inch distance from target to skin, 15–18 milliampere-minutes, no filter. This treatment may be repeated in six to eight weeks. The difference between the dosage applied by Evans and Leucutia and Eller is approximately 500 per cent.

My own opinion is that the maximum dosage mentioned by Evans and Leucutia, that is, seven times an erythema dose, is the minimum that should be used.

I had already arrived at this conclusion from experience when the experimental work of Martin, Quimby and Pack[8] was reported. They found that it required from seven to ten times a skin erythema dose of radon to totally destoy squamous cell cancer.

I believe with Cutler[2] that the difference in sensitivity to radiation of various types of cancer cell is not nearly so great as is commonly supposed, and that the different results obtained are in a large measure due to the physical characteristics of the particular growth.

Basal cell growths are usually more superficial than squamous cell, with much less induration and conceivably might respond to a smaller dose. However, I think it is unwise to make this distinction as it is perfectly possible for basal cell

* Read before the American Congress of Radiology, Chicago, Ill., Sept. 25–30, 1933.

growths to get out of hand and a good proportion of failures occur in this type. For this reason I base dosage on the physical characteristics and the history of the lesion rather than upon microscopic analysis.

The technique which I have employed since 1915 is as follows: 100 kv., 5 ma., 10 inch skin target distance, no filter, exposure time 10 minutes.

Table I

TABULATION ACCORDING TO LOCATION

	Cases Treated Jan., 1926–Jan., 1933	Cured	Recurred	Failed
Epithelioma of the scalp	5	5	—	—
Epithelioma of the neck	3	3	—	—
Epithelioma of the temple	29	22	6	1
Epithelioma of the eyelid	16	14	1	1
Epithelioma of the back	2	—	2	—
Epithelioma of the nose	48	40	6	2
Epithelioma of the cheek	38	34	1	3
Epithelioma of the ear	6	5	—	1
Epithelioma of the lip	29	27	—	2
Epithelioma of the chin	2	1	—	1
Epithelioma of the forehead	11	9	—	2
Epithelioma of the hand	10	8	—	2
Epithelioma of the chest wall	1	1	—	—
Total	200	169	16	15
Precancerous lesions (kerotoses, leucoplakia, degenerating warts and moles)	71	67	—	4

When I made my first report in 1921, I advocated applying one such treatment for small superficial lesions; two treatments with an interval of a day between for lesions somewhat larger; three treatments, same interval, for still larger ones; and four treatments for the most advanced cases. By 1926 I felt that no lesion should receive less than two treatments and today I never give less than three and much more commonly four or more.

An analysis of cases treated always convinces me that the most common cause of failure or recurrence is underdosage.

By experience I had felt that the ten minute treatment described represented from two to three times an erythema dose, depending upon the size of the area treated. Since my last report on this subject in 1930[7] I have confirmed this belief by measurements made with the Victoreen r meter. It is true that the measurements differ to a surprising extent with different tubes, but even those with the poorest output give a dosage somewhat greater than I had expected.

Tubes with a fine focus give smaller dosage than those of medium or broad focus; new tubes give out more roentgen rays than old ones, apparently due to the deposit of metal on the inside of old tubes; and gas tubes fluctuate in their output. Naturally, also, the dose varies with the size of the area treated.

With the factors mentioned above, an old fine focus tube gives 115 r per minute with a 1 cm. area, an old broad focus tube gives 145 r with the same area. An average new medium focus tube gives 150 r per minute with a 1 cm. area and 175 r with a 3 cm. area. The largest measurement I have experienced was with a new broad

TABLE II

FAILURES AND RECURRENCES

	Cases	Apparent Cause of Failure	Final Result
Epithelioma of the nose	8	4—Undertreated 1–2 treatments; 1–2½ treatments; 2–3 treatments	All responded to further treatment
		1—Very extensive involvement of cartilage	Failed
		1—Treated previously elsewhere—small doses at long intervals.	Failed
		2—Unknown cause	1 responded to further treatment 1 did not return
Epithelioma of the chin	1	Postoperative; spread like wildfire	Died
Epithelioma of the temple	7	1—Recurred after filtered radiation	Responded to massive unfiltered radiation
		1—Failed—very large lesion. Recurrent after fractional x-ray many years ago	Died
		1—Recurred—gave only two treatments	Responded to subsequent treatment
		1—Squamous cell with cervical metastasis	Unknown
		1—Was a recurrence after operation	Recurred again after x-ray; final result unknown
		2—Recurred after three years. Cause unknown	1 responded to further treatment 1 final result unknown
Epithelioma of the cheek	4	1—Developed on roentgen reaction after 18 years; very extensive lesion	Final result unknown
		2—Were recurrent after previous fractional x-ray	Finally responded to larger dosage
		1—Extended through to mucous surface	Died
Epithelioma of the eyelid	2	1—Recurred; responded to further treatment	Cured
		1—Was persistent after much x-ray and radium elsewhere over period of years; our treatment ineffectual	Failed
Epithelioma of the ear	1	Case had been operated on; then fractional x-ray; then radium; our treatment ineffective	Died
Epithelioma of the lip	2	1—Old case given much x-ray and radium over period of 5 years; primary lesion healed; died from metastasis	Died
		1—Primary lesion healed; metastatic glands did not respond	Final result unknown
Epithelioma of the back	2	Recurred—insufficient treatment; responded to larger dosage	Both cured
Epithelioma of the forehead	2	Bone involved; lesions very extensive; treatment ineffective	1 died 1 still under observation
Epithelioma of the hand	2	1—Large lesion; did not respond to treatment	Final result unknown
		1—Recurrent after previous radium treatment	Not benefited

focus tube which gave 300 r per minute over a 5 cm. area. All these measurements include back-scattering.

It will thus be seen that a ten minute treatment as described represents a minimum of 1,150 r with a probable average between 1,500 and 2,000 r. Four such treatments which I would consider to be the minimum adequate to destroy squamous cell carcinoma would represent a total dosage between 5,000 and 8,000 r.

This dosage which I have been using now for about eighteen years and which I believe essential to the successful treatment of skin cancer is practically the same dosage which Coutard[1] claims is necessary to destroy malignancy in the pharynx and larynx. For this purpose he applies from 6,500 to 8,000 r. The results which he obtains from his method of treatment are well known and undoubtedly superior, although the reactions which obtain from his method have undoubtedly acted as a deterrent to its general adoption in this country.

Apparently these results show that the lethal dose for carcinoma is much greater than has been generally believed and is probably around 5,000 to 6,000 r.

My own personal belief is that there is little difference in this lethal dose for superficial and for deep-seated malignancy. I also believe that the effect on cancer cells produced by roentgen rays of the different wave lengths now used for therapeutic purposes is not greatly different for the same dosage.

Naturally this makes the treatment of skin cancer very much easier than deep-seated cancer since one can apply any dosage he thinks best. The advantage of using unfiltered radiation for this purpose is that a large percentage of the radiation applied will stop in the lesion and while it will have its effect in destroying the cancer, it will not penetrate the normal structures underneath the cancer and produce undesirable effects there. On the other hand, the use of such large doses, if filtered radiation is applied, is apt to produce a great deal of fibrosis and atrophy of normal structures in the neighborhood of the lesion.

Consequently the application of 5,000 r of unfiltered radiation within a week with the resulting acute reaction is really a safer procedure than the old practice of applying filtered radiation in small doses at intervals of one or two weeks over a period of months, although the total amount of radiation may be much less. Even if the latter method proves successful in eradicating the lesion, the danger of late roentgen reactions is greater.

Precancerous lesions such as keratoses, leucoplakia, degenerating warts and moles, should be treated in practically the same way as basal cell epithelioma. It is well known that any treatment applied to these lesions should completely eradicate them; otherwise it may hasten their degeneration into a true malignant lesion.

The action of the rays is usually facilitated in these cases by the use of fulguration with the high frequency spark before the application of the radiation. This removes superfluous or hard, scaly material and increases the effect of the radiation. The roentgen rays should be applied immediately after the fulguration. One, two, or three treatments may be necessary, depending upon the size and characteristics of the lesion.

Leucoplakia on the lip should be treated the same as epithelioma, but only about two-thirds as much treatment is necessary.

The attitude of mind of the physician treating precancerous lesions should be that he is dealing with a mild malignant lesion and not a difficult benign one. Many epitheliomas develop more rapidly than they otherwise would have done because they were treated with caustics, antiseptics, or other inadequate measures when they should have received treatment appropriate for skin malignancy.

In previous communications I have advised against the use of massive doses to epitheliomas in areas covered with clothing because it is so difficult to get the lesion to heal after the treatment. Further experi-

ence leads me to change my opinion regarding these cases. If subescharotic doses are used the lesion may heal, but it is almost certain to recur. I believe it is better to use full doses and if the resulting ulceration cannot be made to heal, it can be excised.

However, with a little patience most of them will eventually heal. The healing will be expedited if the dressings are applied in such a way that the ulcer is open to the air and not in contact with clothing or dressings. If one is unwilling to embark upon this program involving trouble for the doctor and discomfort to the patient, it is better to resort to surgery in the first place rather than use insufficient radiation. This will almost certainly be followed by a recurrence which is always more difficult to treat than the primary lesion.

To summarize my experience in the treatment of epithelioma, I believe these lesions should be treated with massive doses of unfiltered roentgen radiation. The treatment must be applied over a period which is so short that a single effect is produced by the entire amount of treatment given. In a general way, this period should not be longer than a week. The amount of treatment necessary to produce the greatest number of cures with a minimum of recurrences is from eight to twelve times a skin erythema dose, or from 4,500 to 8,000 r.

After this treatment is given the case should be watched, but in the majority of instances, no further procedure is necessary. The area treated will slough; if it is on the face a scab will form which should not be disturbed and in about six or eight weeks it will have healed over with a pliable and usually inconspicuous scar.

Complicated cases, such as those involving cartilage or bone, may require supplementary treatment other than radiation. Neglected cases and recurrences may prove recalcitrant and fail to respond, but the great majority will yield satisfactorily and remain well if treated in the manner described.

REFERENCES

1. COUTARD, HENRI. Roentgen therapy of epitheliomas of the tonsillar region, hypopharynx and and larynx from 1920 to 1926. AM. J. ROENTGENOL. & RAD. THERAPY, 1932, *28*, 313–331.
2. CUTLER, MAX. Radiation therapy of cancer of the skin. AM. J. ROENTGENOL. & RAD. THERAPY, 1932, *28*, 724–727.
3. ELLER, J. J., and FOX, E. C. Treatment of skin cancer. *N. York State J. Med.*, 1930, *30*, 1344–1352.
4. EVANS, W. A., and LEUCUTIA, T. "Massive" and "hypermassive" radiation in the treatment of skin cancers. *Brit. J. Radiol.*, 1928, *1*, 396–427.
5. GRIER, G. W. Radiotherapy in superficial malignancy. *J. Radiol.*, 1921, *2*, 39–48.
6. GRIER, G. W., X-ray treatment of epithelioma. *N. Orl. M. & S. J.*, 1927, *79*, 508–512.
7. GRIER, G. W. Further observations on the treatment of superficial malignancy. AM. J. ROENTGENOL. & RAD. THERAPY, 1931, *26*, 461–464.
8. MARTIN, H. E., QUIMBY, E. H., and PACK, G. T. Calculations of tissue dosage in radiation therapy. AM. J. ROENTGENOL. & RAD. THERAPY, 1931, *25*, 490–506.

VOL. XXXII, No. 2

CARCINOMA OF THE LIP*

RESULTS OF ROENTGEN AND RADIUM TREATMENT

By BERNARD P. WIDMANN, M.D.
PHILADELPHIA, PENNSYLVANIA

CARCINOMA of the lip, treated with roentgen rays, radium and electrodesiccation, has been analyzed from the standpoint of results obtained with a great variety of technical procedures employed at the Philadelphia General Hospital durin the past ten years. There are 168 cases available for one to ten year classifications. The incidence is about 2 per cent of over 10,000 cases of cancer in ten years.

No attempt will be made to compare the results of surgery as against irradiation. There have been many favorable reports of good results from many large surgical clinics. There is now an apparent tendency to favor irradiation and this inclination is particularly strong in the larger centers with highly organized tumor clinics and excellent facilities for adequate irradiation. The fact that one or the other type of treatment is favored here or there is not always proof of a superior method. Irradiation for cancer of the lip has been uniformly successful for the smaller lesions, and very often extraordinary results are shown for the large and sometimes bulky lesions. The popularity of irradiation procedures has become international. This is undoubtedly stimulated by the relative simplicity of administration as well as the speed and economy with which results are obtained. There is practically no treatment mortality, no risk of hemorrhage or infection, and the cosmetic results are excellent.

There are still many considerations that demand more detailed as well as confirmatory studies. The results of irradiation should be submitted according to the duration of the lesion, extent of involvement, cellular differentiation, the management of the cervical nodes and the exact technical procedures employed. Assuming that every case is an individual problem, there does not seem to be any standard or uniformity of radiation technique even in the largest and best organized radiological clinics.

This material for the most part is probably representative of the average clinic organized for the special care and treatment of malignant disease on a large scale. Of the total of 168 cases, 125, or 74 per cent, were primary cases without recognizable lymph node involvement at the first examination. These were in no sense all early cases from the standpoint of so-called surgical operability. For example: 39 cases were infiltrating in character and in excess of 2 cm. in diameter; 7 of these were 3 to 4 cm. in length. The average duration of these lesions before the first treatment was thirty-nine months. Of 43 clinically late cases with advanced primary lesions and gland involvement, 19 were recurrent cases treated elsewhere with roentgen rays, radium and electrodesiccation, 6 had bloc dissections in conjunction with irradiation of the primary lesion (none had local recurrences), and 14 were hopeless recurrences following bloc dissection and surgical excision of the primary lesion.

To fulfill a comprehensive program of detailed information with respect to each case it was necessary to elaborate a system of tabulation that would automatically classify every case according to the duration, size, and microscopical grading of the lesion, the effects of prophylactic irradiation of the cervical glands, the exact technical procedures with special reference to filtration and dosage of roentgen rays and radium, and the results in terms of longevity for symptom-free and recurrent cases and for cases that showed no benefit.

* From the Radiological Department of the Philadelphia General Hospital. Read before the American Congress of Radiology, Chicago, Ill., Sept. 25–30, 1933.

Every case symptom-free for one year or more was included, but three and five year estimations are also shown.

Every case not traceable or known to have died of intercurrent disease was classified as dead unless there was a symptom-free record for three years or more.

The incidence of age, sex, etc., revealed nothing new or important. A positive Wassermann reaction was recorded in 19 cases but this was not a routine examination until recently. The upper lip was involved in 3 cases; the angle of the mouth in 9 cases.

There were 11 cases with recurrences apparently treated successfully but these are not grouped with the symptom-free cases.

All of the cases were divided into three broad groups; (1) no palpable nodes at start of treatment; (2) definite node enlargement at start of treatment; (3) recurrent cases with extensive neck infiltrations.

Table I

GROUPED ACCORDING TO NODE INVOLVEMENT AND PROPHYLACTIC IRRADIATION

(a)	No irradiation to glands and no subsequent metastases.
(b)	No irradiation to glands with subsequent metastases.
(c)	Prophylactic irradiation and no subsequent metastases.
(d)	Prophylactic irradiation with subsequent metastases.
(e)	Irradiation to enlarged glands present at onset of treat.
(f)	Bloc dissection.
(h)	Recurrent cases following radical surgery.

Table 1 illustrates the classification of cases according to the development of the neck nodes with and without prophylactic irradiation. Special precautions were observed in noting the incidence of subsequent metastases. These groups are adhered to in the subsequent tables and are represented by a, b, c, etc. If no prophylactic irradiation to the glands was given and there was no subsequent node involvement, then the cases were grouped under (a); if subsequent metastases developed they were grouped under (b), etc.

The exact treatment in detail was abbreviated with symbols according to Table II. The number of erythema doses was indicated as 1, 2 or 3 after each symbol. Filter of radium was specified. For example: aER$_2$ag (1) according to Tables I and II indicates that the case received no prophylactic irradiation and developed no subsequent metastases (a), that the primary lesion was electrodesiccated (E), that a local surface application of radium with 0.5 mm. silver filtration was given to the extent of 2 erythema skin doses (R2), the symbol (ag) designating silver filtration, and that the lesion was 1 cm. in diameter (1). Another example of recording technique: cX5H2 (2) indicates prophylactic irradiation with no subsequent development of metastases (c), 5 localized erythema doses of unfiltered roentgen rays—127 kv. (X5), two series of high voltage roentgen rays including the right and left cervical gland regions (H2), and that the lesion was 2 cm. in diameter (2). Each case with an exact account of the treatment was grouped in columns according to Table III. A discussion of the results according to the different technical procedures employed will be taken up later.

Table II

SYMBOLS INDICATING TYPE OF TREATMENT

R	Surface radium applications
X	Localized unfiltered roentgen rays
E	Electrodesiccation
S	Surgery
C	Cautery
H	High voltage roentgen rays
P	Radium packs
G	Gold seeds
Gl	Glass seeds
r	Recurrence
(1)	Size.

Number of skin erythema doses indicated as 1, 2, 3 after each symbol. Filter of radium specified.

Example: aER2ag(1) cX5(1) cR2agrER4pbH2(2)

The results of high voltage roentgen

TABLE III

RESULTS ACCORDING TO PROPHYLACTIC AND NO IRRADIATION TO THE NECK

GROUP	Symptom-Free Years									TOTAL	Symptom-Free then Fatal Recurrence Years									TOTAL	No Benefit Years			TOTAL	Sum Total
	½–3	3	4	5	6	7	8	9	10		½–3	3	4	5	6	7	8	9	10		½–3	3	4		
a	12	5	4	1	2	1	1	0	0	26	2	0	0	0	0	0	0	0	1	3	0	0	0	0	29
b	0	0	1	0	0	0	0	0	0	1	9	3	3	0	1	0	0	1	1	18	19	4	1	24	43
c	17	7	3	4	5	2	3	0	3	44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	44
d	0	0	0	0	0	0	0	0	0	0	1	3	0	0	0	0	0	0	1	5	4	0	0	4	9
e	3	1	1	1	1	0	0	0	0	7	2	1	0	0	0	0	0	0	1	4	1	0	1	12	23
f	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	4	0	1	5	6
h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	0	0	14	14
Total 1 to 10 years										78										31				59	168
Total 3 to 10 years										47										17				3	67

rays or radium packs according to the presence or absence of enlarged neck nodes, or the subsequent development of metastases with and without prophylactic irradiation to the neck is summarized in detail from Table III as follows:

Group (a): No irradiation to the glands and no subsequent metastases: there were 29 cases; of these, 26, or 90 per cent, are symptom-free one to ten years; 15, or 80 per cent of 19, are symptom-free three to ten years.

3 symptom-free for 3 years
4 symptom-free for 4 years
1 symptom-free for 5 years
2 symptom-free for 6 years
1 symptom-free for 7 years
1 symptom-free for 8 years
3 symptom-free for 9 years

Total 15 cases

Group (b): No irradiation to glands with subsequent metastases: there were 43 cases; of these 1, or 0.3 per cent, is symptom-free four years. Of these 43 cases, 9 showed primary healing with fatal recurrences. These cases did not show evidence of metastases at start of treatment but the primary lesions were for the most part large and of long duration. An attempt was made to analyze this group with reference to the size of the lesion, but no substantial criteria can be submitted in this respect. In this group there were 13 cases that were referred from other clinics as recurrences. There were 6 in this group that were recurrent cases treated in this clinic.

3 cases recurred after 3 years
3 cases recurred after 4 years
1 case recurred after 6 years
1 case recurred after 9 years
1 case recurred after 10 years

Total 9 cases

Group (c): Prophylactic irradiation to glands and no subsequent metastases: there were 44 cases; all, or 100 per cent, are symptom-free one to ten years; 27 of these 44 cases are symptom-free three to ten years.

7 cases symptom-free 3 years
3 cases symptom-free 4 years
4 cases symptom-free 5 years
5 cases symptom-free 6 years
2 cases symptom-free 7 years
3 cases symptom-free 8 years
3 cases symptom-free 10 years

Total 27 cases

Group (d): Prophylactic irradiation to the glands with subsequent metastases:

There were 9 cases; none are living. Three cases recurred three years after beginning treatment; 6 cases recurred within six months to two years after beginning treatment.

Group (e): Irradiation to enlarged glands present at onset of treatment. Of 23 cases, 6, or 2.6 per cent, lived three to ten years; 4, or 1.8 per cent, symptom-free three to six years as follows:

1 symptom-free for 3 years
1 symptom-free for 4 years
1 symptom-free for 5 years
1 symptom-free for 6 years
1 symptom-free for 3 years
then developed fatal recurrence
1 symptom-free for 10 years
then developed fatal recurrence

These results indicate the possibility of obtaining gland regression with irradiation. The question of enlarged nodes due to infection is always a strong possibility. The apparent good results in this group represent instances where the node enlargement was localized without apparent infiltration and fixation. In no instance where there was widespread involvement or apparent rupture of the capsule, or fixation and infiltration, was regression obtained.

Of the total of 168 cases, 125 showed no evidence of enlarged nodes at the beginning of treatment. Of 125 cases, 78, or 62 per cent, are symptom-free one to ten years. Of these 78 cases, 47 cases are symptom-free three years or more as follows:

11 cases are symptom-free 3 years
9 cases are symptom-free 4 years
6 cases are symptom-free 5 years
8 cases are symptom-free 6 years
3 cases are symptom-free 7 years
4 cases are symptom-free 8 years
3 cases are symptom-free 9 years
3 cases are symptom-free 10 years

Total 47 cases

Groups (a) and (b) combined with no prophylactic irradiation to neck show that of 72 cases, 27, or 37 per cent, are clinically well one to ten years; of 72 cases, 45, or 61 per cent, developed uncontrollable cervical metastases.

Groups (c) and (d) combined, represent prophylactic treatment with roentgen rays or radium packs to the cervical node region, and of 53 cases, 44, or 83 per cent, are clinically well one to ten years; but of 53 cases, 9, or 17 per cent, developed uncontrollable cervical metastases. This very striking difference of 61 and 17 per cent of metastatic node development without and with prophylactic irradiation to the neck is accentuated by the fact that 8 of the 45 cases developing cervical metastases without prophylactic irradiation to the neck were referred from other clinics with primary healing but with node involvement. If the difference is based on cases from this clinic alone, then there are 37 of 72 cases, or 51 per cent, that developed metastases without prophylactic irradiation.

An attempt was made to determine the end-results according to the size of the lesions as shown in Table IV. These data were controlled by the records and confirmed by an estimation against photographs in 63 cases. In 103 cases the exact size was vague. No attempt was made to determine the end-results in these indeterminate cases, according to the size of the lesion. In many instances an estimation was justified on basis of the size of the radium applicator and number of gold seed implantations. It was felt that the known size in 63 cases was fairly illustrative and a careful analysis of Table IV demonstrates the possible high percentage of so-called cures obtained on the smaller lesions ranging around 1 cm. in diameter. It is significant to note that there was no appreciable difference between the successes and failures for the radium treatment of lesions ranging from 2 to 4 cm. in diameter. This observation justifies the routine procedure of radiation treatment of all sizes of lip cancer. The majority of these larger lesions were readily beyond the scope of surgical operability. A careful study of the records of 103 cases indicates that the failures seem to have been an effect of the long duration of the lesion before treat-

TABLE IV

RESULTS ACCORDING TO SIZE OF LESION

Size	Symptom-Free Years									TOTAL	Symptom-Free then Fatal Recurrence Years									TOTAL	No Benefit Years			TOTAL	Sum Total
	½–3	3	4	5	6	7	8	9	10		½–3	3	4	5	6	7	8	9	10		½–3	3	4		
1 cm.	7	5	2	2	4	0	1	0	1	22	0	1	0	0	0	0	0	0	0	1	0	0	0	0	23
2–3 cm.	8	2	4	2	1	0	0	1	1	19	1	2	1	0	0	0	0	1	0	5	7	0	1	8	32
3–4 cm.	2	0	0	1	0	0	0	0	0	3	3	0	0	0	0	0	0	0	0	3	1	0	0	1	7
?*	15	5	3	1	2	3	3	2	0	34	11	4	2	0	1	0	0	0	4	22	45	4	1	50	106
Total	32	12	9	6	7	3	4	3	2	78	15	7	3	0	1	0	0	1	4	31	53	4	2	59	168

* Accurate sizes not shown in records.

TABLE V

RESULTS ACCORDING TO THE GRADE OF THE LESION

Grade	Symptom-Free Years									TOTAL	Symptom-Free then Fatal Recurrence Years									TOTAL	No Benefit Years			TOTAL	Sum Total
	½–3	3	4	5	6	7	8	9	10		½–3	3	4	5	6	7	8	9	10		½–3	3	4		
I	5	1	0	0	0	0	0	0	1	7	1	0	0	0	0	0	0	0	0	1	7	1	0	8	16
II	7	2	1	0	0	0	0	0	0	10	1	1	0	0	0	0	0	0	0	2	7	0	0	7	19
III	2	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	1	3
IV	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	2
No grade	4	2	3	1	1	0	1	2	1	15	3	4	0	0	1	0	0	0	1	9	12	1	1	14	38
Not conclusive	6	3	0	0	0	1	0	0	0	10	3	1	0	0	0	0	0	0	1	5	0	0	0	0	15
No biopsy made	8	4	5	5	6	2	3	1	0	34	7	1	3	0	0	0	0	1	0	12	26	2	1	29	75
Total	32	12	9	6	7	3	4	3	2	78	15	7	3	0	1	0	0	1	4	31	53	4	2	59	168

ment rather than an effect of the size of the lesion. It was shown in these cases that the average duration of the lesion was forty-three months before any advice or treatment was given. Extensive recurrences of the primary lesions resulting from treatment elsewhere was noted in 17 cases.

The results according to the grade and cellular differentiation of the lesions are shown in Table v. It is regrettable that only 78 of 168 cases had conclusive micro-

scopical studies. The cellular differentiation was checked in 40 cases with a preponderance for Grades I and II. The distribution of cases was so scattered that no satisfactory conclusion with reference to response to treatment according to cellular differentiation can be made. Of 38 cases that showed definite microscopical evidence of carcinoma with no histological grading, the successes and failures are about equal. These results are tenable for the cases in which no biopsy was done. Our clinical impressions warrant the inference that there is a tendency for all lip cancers to be resistant and that too much significance should not be placed upon cellular differentiation for carcinoma of this particular anatomical site. The good results apparently depend upon adequate treatment of small lesions of short duration. Any lesion that is known to exist longer than six months, regardless of its size or cellular differentiation, should be considered dangerous, and the possibility of embolic or permeation metastases ensuing long before there is any palpable evidence of node enlargement must be considered.

An evaluation of the treatment procedures according to Table II revealed some startling and disappointing information. Recurrences were found following apparent radical surgery, electrodesiccation, cautery, paste, radium and roentgen treatments. The cases reported as symptom-free showed a greater uniform success when 5 or more skin erythema doses of radium or roentgen rays localized to the primary lesion were employed. For the smaller lesions success was noted with as little as 3 skin erythema doses. It did not seem to make any appreciable difference as to the quality of rays. The results appeared to be equally good with filtrations of 0.5 mm. silver plus 1 mm. brass, 0.5 mm. silver plus 2 mm. brass, or 3 mm. lead or the equivalent filtration of 2 mm. of platinum. Equally good results were shown with gold seed implantation that were distributed uniformly. In a few instances excellent results were shown with glass seed implantation. The radium applications in all instances involved the surrounding normal tissue that equalled the extent of the lesion. Localized unfiltered roentgen rays, 127 kv., with doses averaging about 5 S.E.D. for lesions 1–2 cm. in diameter and 10 S.E.D. in divided doses for larger lesions showed strikingly good results. Lesions that averaged 1 cm. in diameter treated with electrodesiccation under local novocaine anesthesia immediately after the biopsy and then followed with a localized dose of unfiltered roentgen rays equivalent to 2 or 3 S.E.D. showed probably the best results with very slight deformity.

An analysis of the failures demonstrates apparently inadequate treatment. In almost all instances, the total dose was less than 5 and usually less than 3 S.E.D. Primary healing with subsequent uncontrollable metastases was shown in a few cases that received doses of 5 S.E.D., but the failures were interpreted as an effect of a long duration of the primary lesion—in excess of forty months—rather than an effect of inadequate treatment of the primary lesion.

The large group of cases in which no response to irradiation was obtained shows the futility of irradiation for the majority of advanced infiltrating lesions with complicating mixed infection. In a great many instances the intensity of radiation reached 10 and even 15 S.E.D. with various qualities of radium distributed in the form of plaques and covering the entire inner and outer surfaces of the lower lip and even extending beyond the angles of the mouth.

These observations indicate that carcinoma of the lip will respond to a manifold variety of techniques, but the applications must be made with care so that a free and wide margin of the normal tissues will receive a similar amount of radiation approximately equivalent to 5 S.E.D. Because of the risk of late skin atrophy with softer qualities of radiation, it is recommended that filtrations equivalent to 2 mm. of brass or 2 mm. of platinum be used. Because of the simplicity with which surface applica-

tions can be made, this technique is highly recommended. There is always the risk of infection and the possibility of precipitating embolic and permeation metastasis that must necessarily result from the extent of trauma involved in interstitial irradiation whether with gold seeds or platinum needles.

It should be emphasized that small recurrences responded to electrodesiccation better than with additional irradiation. This statement must be modified with respect to the radiation treatment of recurrent lesions with gold seed implantations. Interstitial irradiation with doses of 5 S.E.D. or more has been effective, particularly for recurrent lesions following irradiation.

SUMMARY

The results of the radiation treatment of 168 cases of cancer of the lip have been analyzed.

Of 125 cases without node enlargement at the beginning of treatment, 78, or 62 per cent, are symptom-free one to ten years; 47 cases are symptom-free three years or more. These results are based on all cases without respect to size. For lesions about 1 cm. in diameter the curability range is greater than 90 per cent.

With prophylactic irradiation of the lymph nodes of the neck, subsequent development of cervical node metastases occurred in 17 per cent of 52 cases as against 51 per cent of 72 cases that developed uncontrollable cervical node metastases without prophylactic irradiation.

There is evidence to indicate that the best results are obtained in small lesions—1 cm. in diameter or less—and with adequate treatment of lesions of short duration.

This study does not reveal any substantial information with respect to results and microscopical grading. The great majority of cases were low grade malignancies. This supports the clinical impression that the majority of carcinomas of the lip should be regarded as resistant lesions.

No uniformity of irradiation technique has been adhered to. Free and wide electrodesiccation in conjunction with radium or roentgen rays—localized dose of 2 S.E.D.—is favored for the small lesions. Larger lesions should be given at least 5 S.E.D. to include a surface surrounding the lesion equal to the size of the lesion. The effects of different qualities of radium and roentgen rays have been observed to be equally good. Filtrations equivalent to 4 mm. of lead are preferred because the shorter wave length rays do not seem to produce the degree of atrophy that is theoretically more likely with softer qualities and doses equal to 5 S.E.D.

There is no evidence in this study to indicate that irradiation will consistently effect regression of metastatic nodes. On the basis of this experience, the recommendation of surgical excision seems justified for isolated, freely movable nodes that develop after apparently adequate high voltage roentgen rays or radium packs. The total surface dose should be at least 2 S.E.D. (1,600 r). Interstitial irradiation should be reserved for isolated inoperable nodes.

There is abundant evidence to warrant the recommendation of prophylactic irradiation to the cervical node region.

No comparison with surgical statistics was made because more than 25 per cent of the cases without gland involvement at the first examination, showed an extent of involvement of the primary lesion that is ordinarily regarded as inoperable except with plastic procedures.

ROENTGEN THERAPY IN DERMATOLOGY*

By JOSEPH JORDAN ELLER, M.D.
Assistant Professor of Dermatology and Syphilology, New York Post Graduate Medical School and Hospital, Columbia University
NEW YORK CITY

THE therapeutic potency of roentgen rays is well established and leads the field of dermatologic physical therapy. In some cases such as mycotic infections (ringworm and favus) of the scalp, keloidal formations and hyperidrosis, roentgen rays alone can improve the condition. In other conditions, such as plantar warts, beard infections and epitheliomas, this method of therapy is most valuable. In psoriasis, eczema, lichen planus, ringworm of the glabrous skin, certain epitheliomas, etc., roentgen rays are used in combination with other medical or surgical procedures.

Radium, even though it is not used as extensively as roentgen rays, is often a great aid to the dermatologist. It has a distinct advantage in the treatment of certain lesions, such as epitheliomas or keratoses located near the inner canthus of the eye or the alae of the nose. Also radium gives by far the best cosmetic results in angiomas and certain other vascular nevi.

Grenz rays are roentgen rays of extremely long wave length (8–10 kv.) and are useful in the treatment of a limited number of dermatoses. It is my opinion that they will not replace the wave length of roentgen rays (a peak voltage of 100 kv.) which are commonly used by dermatologists in this country and abroad. The latter rays are useful in over fifty different skin conditions, while the grenz rays, due to their limited penetration, affect fewer dermatoses.

As a rule, grenz rays to be effective must be used in larger doses. Due to their limited penetration, the grenz rays have a much greater degree of safety, but in excessive doses the latter may also cause undesirable sequelae. When grenz-ray sequelae do occur they are of a much milder character than those of the usual wave length roentgen rays.

The following skin diseases are the ones in which I have found the grenz rays to have a distinct usefulness:

1. Multiple flat epitheliomas of the skin. For this condition six to eight times the erythema dose is necessary. Usually one such dose suffices, but if another is needed, it could be repeated in eight weeks.
2. Verrucae planae of the bearded region and other areas of the skin.
3. Localized neurodermatitis.
4. Eczematous conditions of the scalp, eyebrows and eyelids.
5. Certain cases of dermatophytosis of the glabrous skin.
6. Sarcoids.
7. Superficial lesions of lupus vulgaris.

The treatment of port-wine marks and angiomas with grenz rays in my experience has been unsatisfactory. Acne rosacea and psoriasis were not sufficiently influenced to warrant their usage. The claim that skin diseases could be influenced by the systemic effects of grenz rays was not corroborated.

I feel that certain dermatologists should continue treating various types of dermatoses with grenz rays or "oversoft" roentgen rays with a thought of perhaps using them with a slightly higher voltage and therefore more penetrating power. This would increase the range of diseases to be treated with grenz rays and even then with a greater degree of safety than that to be expected from the higher voltage roentgen rays.

The principal biological effect of roentgen rays is believed by some to be a func-

* Read before the American Congress of Radiology, Chicago, Ill., Sept. 25–30, 1933.

tional inhibition; others believe that their action is stimulating. With the exception of nerve tissue, cells or tissues having specialized functions respond more quickly to irradiation than the less highly specialized tissues. In treating superficial malignancy, roentgen rays are used to inhibit or destroy the reproductive activity of the cells. Embryonic, reproductive and secretory cells respond to irradiation more readily than do other types of tissue. Rapidly growing cells with numerous mitotic figures are more responsive than slowly growing proliferative cells.

In the various inflammatory conditions the cellular infiltration is a criterion as to its radiosensitivity. Lymphocytes, polymorphonuclear leucocytes and connective tissue wandering cells are most readily influenced by irradiation. Fibroblasts found in the chronic inflammations are more resistant. Giant, epithelioid and plasma cells are very resistant.

Roentgen rays are used in dermatology for the following: (1) conditions in which it is desirable to epilate hair temporarily, such as tinea capitis, favus, sycosis and nevus pilosis; (2) to reduce the activity of of the sebaceous glands as in acne vulgaris, acne rosacea and seborrhea; (3) to inhibit the function of the sweat glands as in hyperidrosis, bromidrosis, chromidrosis, pompholyx and hydrocystoma; (4) to change the metabolism of the regional cells or produce an environment that is less favorable for the growth and reproduction of bacteria and fungi as in skin tuberculosis, sycosis vulgaris, fungus infections, selected cases of furunculosis, acne varioliformis, etc.; (5) for the relief of pruritus.

Most superficial therapy is done with unfiltered radiation. Only a few dermatoses are treated by filtered roentgen rays. In sufficient doses soft roentgen rays can produce a caustic and destructive effect.

The dosage of roentgen rays has in the past been based upon the skin unit, i.e. the dose which is required to produce a temporary epilation of the hair of the scalp. Translated into roentgens, 1 skin unit is equivalent to about 350 r.

Variations in susceptibility to irradiation play an important rôle in the production of sequelae. Eighty-five r may be applied to the face once weekly for three months. Occasionally an individual of the blonde type will exhibit an erythema following the administration of this dose. Telangiectases have resulted in several instances from the use of a dose of 170 r at two week intervals in which an erythema did not appear. In a small number of cases this also resulted following a few 85 r doses once weekly. It is probable that an erythema may have occurred in these patients which was of mild character and was unnoticed or that the reaction was covered by the use of some local application or was considered to be due to some topical application. It is important to avoid even the slightest visible reaction. Definite reactions are of course justifiable in the treatment of neoplasms.

Telangiectases subsequent to irradiation usually occur within two years although they may not appear until the third, fourth or even the fifth year. An area thus affected may be accompanied or followed by other sequelae such as atrophy, pigmentation, depigmentation, keratoses, ulcerations and, later, even epithelioma, depending upon the intensity of the reaction. Care must be observed in the treatment of highly inflammatory lesions as the effect of the roentgen rays may be increased during such an active stage.

Acute and chronic simple inflammatory dermatoses which involve predominantly the epidermis may be treated by fractional unfiltered irradiation of $\frac{1}{8}$–$\frac{1}{4}$ erythema dose, i.e., 42–85 r once weekly. Lesions situated deeply in the cutis, lesions with considerable infiltration, the more extensive neoplasms and larger granulomas require more intensive treatment. This is accomplished by the use of various filters. Most dermatologists use aluminum as a filter. This is used in 1, 2 or 3 mm. thicknesses.

Acne vulgaris, a skin eruption consisting

of comedones, papules and pustules or nodules, usually superimposed on an oily skin, responds exceptionally well. This therapy should be used in conjunction with constitutional measures and mild topical applications. Usually fractional doses (85 r once weekly) of unfiltered roentgen rays are employed, resulting in the contraction of the overactive sebaceous glands. Most patients obtain a satisfactory result in about three months under a combined regimen of treatment (systemic and local).

Rosacea is responsive when the predominant lesions consist of papules and pustules. When the lesions consist of diffuse erythema and telangiectasia the results from irradiation may be disappointing.

Eczema. This term covers a wide group of dermatologic conditions which may be either acute or chronic and which may appear at any age. Most eczemas will improve under fractional radiation therapy. The acute type should receive very small doses of roentgen rays, preferably using the subfractional method (21–42 r doses).

Neurodermatitis is affected rapidly and favorably in most cases. Fractional doses are used. When lichenification is marked, the dosage must necessarily be increased.

Dermatophytoses may include any eruption of eczematous character that is produced by the "trichophyton" or "epidermophyton" and includes eczema marginatum of the groin, eczematoid ringworm of the hands and feet, etc. Irradiation is administered in conjunction with weak antiparasitic applications. Roentgen rays are more effective in the acute type of eruption. Good results may follow a few fractional treatments. Recurrences, however, are common. Frequently ringworm eruptions require months for complete eradication and *it is inadvisable to continue irradiation for such a long period.*

Psoriasis. Extreme caution and good judgment must be employed in the selection of cases not only to obtain good results but in order to avoid sequelae. In the average case of psoriasis it is probably best to give as little roentgen radiation as possible and depend mostly on topical applications. The best plan is to give two, three or four fractional doses (85 r) at weekly intervals. When the lesions begin to disappear, roentgen treatment is discontinued and local medication is applied. If the lesions fail to respond, that is, become "roentgen fast" is it *useless to continue irradiation.*

Lichen planus, both the acute and chronic type, responds more or less to roentgen rays. Irradiation, using fractional doses, may cause involution of the lesions and afford quick relief from itching. Mercury and arsenic medication internally in conjunction with irradiation may hasten involution of the lesions. The acute erythematous type responds more quickly to treatment than the chronic hypertrophic lesions. Lichen planus lesions of the mouth are resistant to irradiation. I believe that radium is contraindicated for such mouth lesions. They are safe to leave untreated as they usually cause no symptoms.

Tinea capitis and favus. When these cases are treated by local applications they frequently require months or even years for their permanent removal. It is far more advantageous to epilate the scalp with roentgen rays, following which local applications are used. By this method a satisfactory result is obtained in almost 100 per cent of the cases. A dose of 340 r is applied to five scalp points according to the Adamson-Kienböck method. Only one such exposure is necessary. The hair falls out in seventeen days and with it the fungi and spores. Then antiseptic salves are applied daily until the hair returns.

Pityriasis rosea frequently responds very quickly to fractional doses (42–85 r) of roentgen rays. Most of the lesions disappear in two or three weeks under this therapy.

Mycosis fungoides. The effect of irradiation on the early eczematous lesions of mycosis fungoides is frequently spectacu-

lar. Patients covered with lesions and suffering intensely from itching may be clinically improved by a few weekly fractional doses of roentgen rays. Although lesions usually recur rapidly and the disease eventually ends fatally (three to ten years) it is possible to make the patients quite comfortable for some months.

Furuncles. Irradiation is of distinct service in selected cases. A 3 mm. aluminum filtered roentgen-ray exposure in a dose of 75 per cent of a unit may cause either a rapid involution or there may be an expulsion of the pus from the furuncle in its early stage.

Hyperidrosis. Satisfactory relief of this condition may be obtained by five doses of roentgen rays using a filter of 1 mm. Al to the affected areas at intervals of ten days in $\frac{1}{4}$ of the skin tolerance dose.

TRAINING FOR RADIUM THERAPY*

By WILLIAM H. CAMERON, M.D.
NEW YORK CITY

TO OUTLINE a system of training for radium therapy acceptable to the members of this Congress and at the same time attempt to bring the indifferently interested physician, the occasional user and the not-too-well informed critic to a proper evaluation of radiation possibilities, seemed a commonplace task. However, I found the subject covered so many items that all I can hope to accomplish within the time limit is to stimulate collective thinking and doing in respect to certain educational reforms.

Our educational efforts have, for the most part, consisted in demonstrating the value of this or that form of radiation. The experienced radium therapist realizes that all forms must be modified to meet individual case eccentricities in size, location and susceptibility, but because basic principles are not always understood, modifications are not always made and the full possibility of the method is lost—and radium therapy is misunderstood.

Take this incident as an example of the failure to observe technical details. After the establishment in 1913 of an accurate system of measuring the radioactive strength of therapeutic units, it was discovered that the units used previously varied 25 to 95 per cent from their supposed strength and this disregard of one technical detail, although entirely unknown, prevented acceptance of clinical data compiled during a period of about fifteen years.

In my opinion, the correction of this error marked the beginning of a second period in radium therapy and while we who became interested at this time had certain advantages we soon learned that many other difficulties had to be overcome. For instance, rays were not homogeneous and lesions must be homogeneously irradiated. Rays presented vast differences in their tissue penetrability, and intermediate tissues in deeply seated lesions must be protected from excessive doses by rays of less penetrating power.

I cannot take time now to give credit where credit is due but during the years that followed, fairly accurate methods for screening undesirable rays were developed; applicators better suited for delivering homogeneous doses were designed; radiation intensities were brought under control and it gradually became apparent that certain intensities produced fairly consistent tissue reactions. It seemed possible, therefore, to correlate penetrabilities, intensities, reactions and results and thereby establish fixed or standard doses for this or that condition.

After prolonged efforts in this direction, it was found that reactions produced by fixed doses did not, in lesions of the same general type, always produce consistent results; furthermore, results in lesions reported to be exactly the same type were sometimes surprisingly good, sometimes indifferent and sometimes decidedly bad, and the same results were frequently noted when intensities were lowered or when they were stepped up to the limit of surrounding tissue tolerance.

Finally, it was concluded that rational irradiation consisted in delivering homogeneous intensities sufficient to control the inherent susceptibility of the lesion, and whether or not a lesion was wholly, partially or not at all radiosensitive became an added responsibility, and this responsibility marked a third period in radium therapy.

With radiological experience, with diagnostic ability, with pathological help, with knowing how to give, and how to read the results of susceptibility test doses, many lesions may now be listed by what may

* Read before the American Congress of Radiology, Chicago, Ill., Sept. 25–30, 1933.

be called their gross susceptibility, and such a list should be established by some constituted authority. There will, of course, be a doubtful list but some of these cases can be accepted or rejected by microscopical grading.

Consider the past from a somewhat different viewpoint: Notwithstanding the technical and biological difficulties encountered, authentic data covering a rather wide and diversified therapeutic field accumulated. On the other hand, many applications were made under the impression that a radiation dose was just a radiation dose with no contraindications. Failure percentages were, then, unnecessarily high, justifying perhaps the indifference with which many physicians considered radium therapy. Yet there can be no possibility of doubt that we were in some measure responsible for conditions.

It is true, of course, that a natural antagonism existed towards physical agents in grave pathological conditions. It is true that results obtained in well-advanced cases were, as a rule, compared with surgical removal carried out during favorable stages; it is true that the radium therapist experienced difficulties in obtaining suitable cases and it is true that many obstacles of like nature retarded progress; nevertheless we talked about radium without saying anything about the flexibility of its rays through which it derived its multiple therapeutic possibilities.

Then, too, we coined terms that described applicators and not the character of the radiation delivered; we used dose-equations that implied a simplicity in technique that did not exist and we brought forward—sometimes prematurely and over-enthusiastically, perhaps,—many ideas and forms of radiation. This last item, of course, denoted progress but it certainly confused the casual observer.

For our own good, it is time to clarify certain technical matters; it is time to place certain items before the medical profession in their proper light; to suggest that something be done towards the general education of the medical student in respect to radication indications and to urge that technical training and clinical experience be required of physicians desiring to use radium rays routinely or occasionally.

GENERAL EDUCATIONAL PROBLEMS

There is a widespread belief that radium rays as ordinarily used will cause the same dire symptoms reported as being due to accumulated amounts of radium element in the tissues. Unfortunately, this "radium poison" idea is fostered by many members of the profession and should be dispelled by the official act of an authoritative body.

Because, perhaps, they have a common symptom, the treatment of conditions classified under the general term "cancer" is usually decided by whether this symptom has, or has not, developed beyond the so-called operable stage. In the light of recent pathological studies and because rational irradiation has proved its worth in certain types of malignancy, and at less tissue sacrifice and primary mortality cost, the radiologist is justified in asking that this familiar expression be somewhat modified and also in demanding that cases be irradiated in their early stage.

There are sufficient data at hand to demonstrate beyond the possibility of doubt that radium rays have curative and palliative possibilities in a wide and diversified therapeutic field and because the rays must be diversified to meet these various conditions and because each ray intensity used is, as a matter of fact, a separate and distinct form of treatment, it should be generally understood that radium is the axis around which is constructed a therapeutic system, complete in itself. This fact, too, should be generally understood, that proficiency in this system means: (1) knowledge of the physical properties of the rays; (2) an understanding of their biological possibilities; (3) detailed technical acquaintance with all methods used to put these effects into force, and (4) to select or reject cases with discrimination, clinical experience, sound radiological judgment,

diagnostic ability, pathological background and a full appreciation of the value of other methods used in parallel conditions.

PROBLEMS IN TRAINING FOR RADIUM THERAPY

Training for the physician desiring to use radium routinely is discussed later. Whether or not all or only a part of the subject matter should be presented to the medical student is an open question. But no matter what material is presented, it should be given by consent of the entire staff. Why? Because it is the unqualified statements incidentally expressed by various members of the staff that confuse the student and cause his indifference.

Several years ago, I attended a surgical clinic. The case was a hip amputation for a large round cell sarcoma above the knee: a beautiful operation and I mentioned this fact to a senior student. Imagine my surprise when he said, "Our professor of pathology advises us that these cases should be treated by roentgen rays and I believe the operation was not necessary." This is the only favorable comment on radiation therapy I have heard from a medical student.

For many years I noted the questions asked by physicians attending clinics, and the nature of these questions convinced me that a course in technical training should precede clinical attendance. As previously stated, it is impossible to discuss now all the technical points necessary to be considered in a course of this character. But as far as my experience goes, the problems hereafter mentioned seem to give the most concern.

PHYSICAL PROPERTIES OF THE RAYS

A study of the physical properties of radium, and other radioactive elements, contains much of interest to the physicist, the research worker and the teacher. How far one should go in this direction is of no moment but those concerned with the clinical application must know about the disintegration of radium, radon, Ra A, Ra B and Ra C, the decay periods of each, and what might be called their colony production of the alpha, beta and gamma rays. Then, because these rays endow the element, radium, and the gas, radon, with therapeutic properties, their character; their speed; their tissue penetrating power; their volume, and their percentage absorption by inert substances and by distances must be considered in detail.

PREPARATION OF RADIUM AND RADON

The various radium salts should be described and the production of radon explained. The therapeutic advantages of radium and radon are weighed one against the other. The measurement of radium and radon and the terms used to express amounts of each are considered and, if possible, the various approved radium and radon containers are displayed and their mechanical advantages and disadvantages, together with their special uses, described.

SCREENING

Screening is one of the most misunderstood technical problems in radium therapy. Why are alpha rays not used in local applications? Why must one know the screening capacity per fraction of a millimeter of the heavy metals? Why must the operator guard against digital and general exposure? These and numerous other questions dealing with this important subject must be answered and it is well to discuss them under: alpha-ray absorption; primary beta-ray screening by tissues, by distances and by metals; secondary beta-ray absorption; gamma-ray screening by distances, by tissues and by metals, and protection methods.

BIOLOGICAL ACTION OF RADIUM RAYS

The caustic effect is microscopically and clinically tangible and it is perhaps reasonable to conclude that this effect, modified to meet individual case needs, forms the foundation of rational radiation.

On the other hand, there exists clinical evidence to demonstrate that certain pathological conditions are so radiosensi-

tive that their complete disintegration may be brought about with a radiation intensity considerably under that required to produce mild caustic reactions. It is also clinically evident that other lesions present a marked resistance—so marked that it may only be broken down with an intensity sufficient to produce necrosis, and between these extremes, there is a large group, the cells of which seem to present a degree of susceptibility not in accord with the degree presented by the supporting tissues, and in this particular group, radiation complexities multiply exceedingly.

In a practice limited to the irradiation of epidermoid carcinomas, one might consider the caustic action all-sufficient; otherwise a much broader prospectus is needed. So far as empirical effects are concerned, at the present time, what is said is open to question; nevertheless, for educational purposes, one must visualize clinical possibilities.

Combining microscopical evidence with clinical findings, and using self-explanatory terms, I find it serviceable to describe "key" reaction possibilities such as: mild, medium, full caustic effects; autolytic effects and growth retardation effects, the purpose being, of course, to convey the following general radiation ideas:

In wholly radiosensitive lesions, almost any form of radiation that provides for homogeneous doses may be successfully used. In partially sensitive lesions, remarkable palliation, or growth retardation, may be had with any well-balanced technique, when the supporting tissues are radiosensitive but these effects are not so marked when the cell resistance is high.

The curative possibility in partially radiosensitive lesions is another matter. If the "gross" susceptibility and the "key" reaction possibility seem to balance, all that is then necessary is to estimate the intensity and penetrability needed by considering: the stage of the disease; the age and general condition of the patient; the location, size, shape, fixation, induration and consistency of the lesion; the blood supply and tumor circulation; the lymphatic drainage; the resisting power of the surrounding tissue and the possibility of extension. Need more be said in favor of clinical training for radium therapy?

METHODS OF APPLICATION

Step by step, new and better methods for utilizing radium rays were brought forward and it became increasingly apparent that one proposing to cover the entire field needed considerable equipment, and, in my opinion, the equipment necessary is a question to be decided by joint action of representative physicians with long experience.

For educational purposes, radium rays are divided into two major forms: primary beta-ray radiation and gamma-ray radiation, and for lack of time, we will here consider gamma-ray radiation only.

When not analyzed, methods for utilizing gamma rays are many and varied, and the investigating general practitioner decides that radium therapy is not sufficiently stabilized. The novice is disappointed because the one method he selected did not produce the expected result in one case and he is no longer interested. The surgeon is convinced that his curative percentages are not bettered and continues to operate on all cases and he thinks that radium is radium—and so it would seem that we must clear up this situation.

When modern methods of irradiation with gamma rays are analyzed, it is found that they are designed to give either a "contact," a "distant" or a "buried" dose and as these terms actually describe how the radium or radon is used, I see no reason for using special terms.

It is true that point source, strength and screening may differ materially but this difference may be covered in the dose equation and certainly our present dose equations need reforming. It is true that there might be some confusion about the distance demarcation between a "contact" and a "distant" dose but this may be

solved by having an arbitrary maximum distance of, let us say, 10 mm. for a contact dose.

It has been said that the intensity of the dose delivered is an important factor in technique, and this is true, but how can the intensity of a pack, tray, bomb, cast, mask, various needles and radon seeds be estimated if we say that we used a pack or buried a needle for "so many" milligram-hours?

Applicators used for holding radium in contact or devices used to hold radium at various distances should be described for what they are—mechanical contrivances—and coined terms that imply a special form of treatment should be discarded.

I have discussed methods of application for many years, and while I used abbreviated terms in the long ago, I cannot do it now—not outside radiological circles—if I want to be understood. We may say that we used a "low intensive buried dose" or a "high intensive contact dose" and we will be close to having an abbreviated descriptive dose equation when we decide by joint action what constitutes a "low" and a "high" intensity. But if technique is to be duplicated—and it will be duplicated if it is promising—we must at least state essential technical facts and trust that the physician making the duplication will also make the necessary modifications. That is all we can do, short of writing a book to accompany each application, to keep radiological "failures" at the lowest possible point.

DOSE EQUATIONS

If asked to point out the one item that causes the greatest confusion in respect to radium therapy, I would not hesitate to say—milligram-hours, millicurie-hours, or millicurie-destroyed-hours. Such general dose terms say nothing and imply much and that is not the way educational progress will be made.

Vol. XXXII, No. 2

STUDIES ON THE EFFECT OF CONTINUOUS EXPOSURE OF MICE TO GAMMA RAYS OF RADIUM*

By J. FURTH *and* D. H. KABAKJIAN

From the Henry Phipps Institute and Randal Morgan Laboratory of Physics, University of Pennsylvania, Philadelphia, Pa., and the Department of Pathology, Cornell University Medical College

NEW YORK CITY

OUR studies on the effect of continuous exposure to gamma rays of mice with leucemia and tumors began in the Fall of 1930. At that time, we knew of no reports on the effect of continuous exposure of the whole body to a more or less constant source of radiation. Our experiments were undertaken in the hope that they might lead to an improved technique in the treatment of malignant processes which are distributed throughout the body. At present there is an increased demand for very high voltage machines for total irradiation of the human body, although experimental work that would suggest the efficiency of this procedure is wanting.

TECHNIQUE

First Method. Mice were placed in metal cages that contained the radioactive substance in the central part, as illustrated in Figure 1. The source of radiation consisted of small sealed glass tubes containing measured amounts of radium. These tubes were placed in brass capsules of 0.5 mm. wall thickness and then placed inside the aluminum tube that was attached to the center of the bottom of the cage. The aluminum tube was later replaced by a glass test tube (10×1 cm.) that was inverted over a supporting cork, screwed to the bottom of the cage. The distribution of radiant energy reaching the animal under the conditions described was not uniform, decreasing radially from the position of the radium. Assuming an average constant distance from the tube, the rate of irradiation can be roughly estimated. The combined thickness of the tubes was sufficient to eliminate all of the alpha and practically all of the beta rays.

Second Method. The radioactive matter was deposited on pads 4 inches in width and these pads were placed on the outside of an aluminum cage. The space in which the mice lived was more uniformly irradiated by this method than by the first method described above. The combined thickness of the aluminum and the pads was sufficient to absorb all of the alpha and beta rays given out by the radium. This method was first used but abandoned in spite of its superiority because it required much larger amounts of radium.

The methods of inoculation and the transmissible strains used have been described in the article of Furth, Seibold, and Rathbone.†

EFFECT OF CONTINUOUS GAMMA IRRADIATION ON THE BLOOD AND ON THE LENGTH OF LIFE OF HEALTHY MICE

This preliminary study was undertaken to determine: (*a*) the effect of irradiation of different intensities on the blood-forming organs; (*b*) the limits of intensity of irradiation to which healthy mice could be exposed continuously without fatal injuries; (*c*) the limits of total quantity of irradiation of different intensities to which healthy mice could be exposed without fatal injuries.

Mice were kept continuously in cages such as shown in Figure 1, containing from 0.003 to 5 mg. radium.

Table 1 shows that 1 to 5 mg. of radium shortens the life of the animal, but below this dose radium has little if any effect. Mice exposed to 5 mg. radium lived for an average of sixty-six days, those exposed to 2 mg. of radium for 106 days, and those exposed to 1 mg. for 190 days.

At the beginning of the experiments full grown

† Furth, J., Seibold, H. R., and Rathbone, R. R. Experimental studies on lymphomatosis of mice. *Am. J. Cancer*, 1933, *19*, 521–604.

* This investigation has been supported by a Fund for the Study of Leucemia.

young mice from seven to nine months of age were used, and later, younger mice were used. This fact, and death due to intercurrent diseases and the small number of mice in each group account for some of the differences in the average length of life of mice of the groups shown in Table 1.

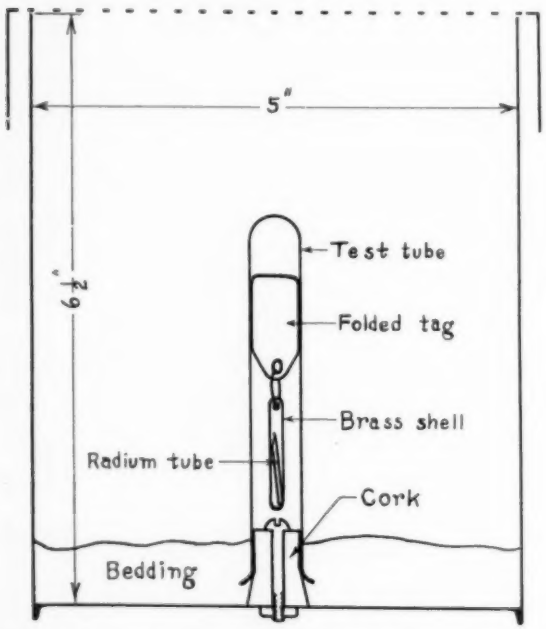


FIG. 1. Showing cage used for continuous exposure of mice to gamma rays of radium.

TABLE I

THE EFFECT OF CONTINUOUS EXPOSURE TO GAMMA RAYS OF RADIUM ON THE LENGTH OF LIFE OF MICE

Amount of radium	No. in group	Length of life after exposure	
		Individual figures	Average
mg.		days	days
5	8	24, 43, 54, 61, 63, 69, 103, 114	66
2	5	41, 106, 108, 109, 168	106
1	4	151, 169, 209, 231	190
0.3	4	149, 319, 424, 460	338
0.1	4	57, 123, 329, 443	238
0.03	4	91, 119, 171, 396	194
0.01	3	222, 695, 827	581
0.003	4	96, 480, 544,* 710*	457

* These two mice died of myeloid leucemia.

Blood counts are a very delicate index of the effect of irradiation. Figure 2 shows that the leucocyte count of a mouse exposed continuously to 5 mg. of radium dropped much below normal within eight days after exposure, yet the mouse lived for 106 days in spite of the uninterrupted exposure to the same quantity of rays. The decrease of lymphocytes during the entire period of exposure was more conspicuous than the decrease of the polymorphonuclear leucocytes, and this was true for all the other mice of this group.

Notes to Figure 2. The curves show the relation of the duration of exposure to the number of white blood cells after exposure. The absolute number of all leucocytes is indicated on the vertical line.

The following are some additional data on the incipient drop of the leucocyte count after exposure to 5 mg. of radium. It dropped from an average of 11,760 to 2,100 and to 3,000 on the third day, to 2,700 on the fourth day, to 4,400 and 4,600 on the fifth day, and to 3,700 on the sixth day. Each of these counts was made on a different mouse because of the difficulties of making accurate counts on the same mouse at frequent intervals.

Gamma-ray injury was the primary cause of death in these mice, but in some death was much hastened by intercurrent disease.

The fate of a few mice removed from the radium jars after an exposure of 4, 9, 16, 28, 43, and 66 days' duration was as follows:

Duration of exposure	Return of leucocyte counts to approximately normal	Length of life*
days	*days*	*days*
4	5	105
9	7	58
16	7–14	39
28	7–29	143
43	14–21	26
66	—	28

* After discontinuation of exposure.

It seems from these meager observations that recovery may be complete even after continuous exposure for four weeks to the gamma rays of 5 mg. of radium, but increased susceptibility of irradiated mice to infections may lead to an earlier death.

There are many factors that influence the effect of irradiation, although it depends primarily on the amount of energy

absorbed. The repair of injuries caused by irradiation is facilitated by extending the time of exposure and decreasing the dose per unit time, thereby not altering the total quantity of radiant energy administered. On the other hand, increased susceptibility to infections and probably also to toxic substances shortens life.

Blood changes following exposure to 1 mg. of radium are shown in Figure 3. During the first two weeks of irradiation there was already a conspicuous drop in the leucocyte count of this mouse; nevertheless, it lived for 208 days after exposure and died at the age of sixteen months.

The figures of Table 1 do not prove that the life of mice is shortened by exposure to 0.3 mg. radium. Nevertheless, Figure 4 indicates that irradiation by 0.3 mg. radium depressed the leucocyte level of the circulating blood. This mouse died after 290 days of exposure at the age of 19½

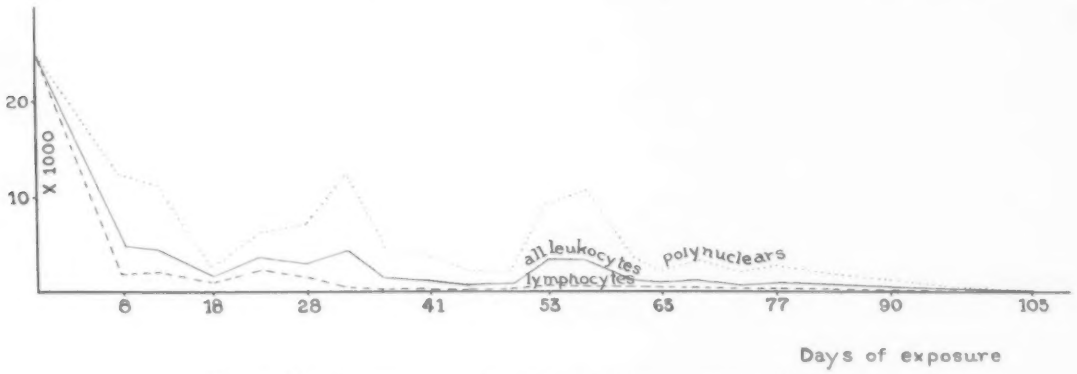


Fig. 2. No. A2793 exposed continuously to 4.95 mg. of radium.

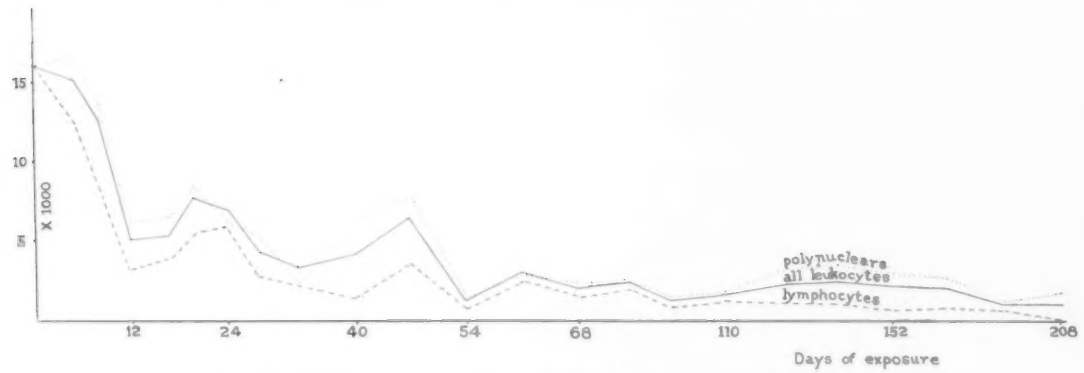


Fig. 3. No A2310 exposed continuously to 1.1. mg. of radium.

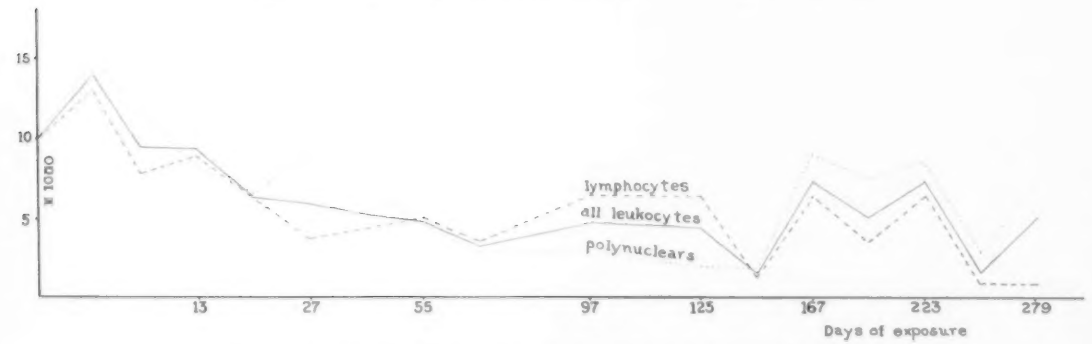


Fig. 4. No. A2324 exposed continuously to 0.3 mg. of radium.

Table II

LEUCOCYTE COUNTS OF MICE EXPOSED CONTINUOUSLY TO RADIUM

Amount of radium (mg.)	5.0		2.0		1.1		0.3		0.1		0.03		0.01		0.003	
No. of mouse	A2793	A2797	Af199	A3825	A2310	A2413	A2324	A3098	A2958	A2961	A2856	A2987	Af157	Af158	Af155	Af156
Leucocyte counts before exposure:	25,000	10,000	5,200	11,000	16,200	11,700	17,500	12,000	18,500	6,500	10,000	16,000	5,000	7,000	6,300	11,300
after exposure:																
1 to 5 days					15,200 to 7,700	10,500 to 8,800			17,700							
6 to 10 days	4,600 to 1,300	4,400 to 2,500			12,200 to 5,100	7,000 to 4,200	9,400 to 6,300				5,200					
11 to 20 days									10,500			14,700				
21 to 30 days	3,400 to 3,000	1,500 to 2,600		10,000	7,000 to 4,300	4,700 to 3,800	5,900	17,000		9,100	8,400	11,500	12,000		15,500	
1 to 2 months	3,900 to 3,100	2,700 to 600	1,500	7,800	2,900 to 3,100	2,700 to 4,100	5,200 to 4,800	5,500 2,900	11,500 to 12,900	4,700	6,400 to 6,600	16,400 to 26,100		8,600		8,300
2 to 3 months	1,100 to 400	1,000 to 200		1,700	2,100 to 2,500	6,200 to 3,000	3,300	7,000	9,800	11,600	6,300 to 3,400	22,000	8,000		5,000	
3 to 6 months	66		1,400 to 540		1,500 to 1,100	1,000 to 2,600	4,800 to 7,300	2,900 to 6,000	9,900 to 5,300	14,000	7,600 to 8,800	29,500	11,000	11,900	8,900	4,400
6 to 9 months					1,100	5,200	5,100 to 1,700	8,000 to 7,800	3,100 to 7,000				9,700	6,100	8,400	4,600
9 to 12 months							5,000 to 8,000	5,800	10,000 to 17,500				8,000	14,600	13,000	6,000
1 to 2 years								6,000					9,300	6,200	6,600	7,800 to 6,200

months, and at necropsy a tumor was found in the ovary, probably an endothelioma, and another in the lung, papillary adenoma. The lymphatic tissues of this mouse were atrophied and there was myeloid metaplasia in the spleen and liver. It is obvious that therapeutic doses must be larger than 0.3 mg.

One mouse (No. Sm 176) exposed continuously to 0.1 mg. of radium died of aleucemic lymphomatosis on the 275th day of exposure, at the age of twelve months.*

Table II shows additional data on the effect of continuous exposure of mice to from 0.003 to 5 mg. of radium on the leucocyte counts. Before exposure to radium the leucocyte counts of these sixteen mice varied from 5,000 to 25,000 and averaged 9,800.

There was a transient drop in the number of leucocytes to 3,100 in one of the two mice exposed to 0.1 mg. of radium and to 3,400 in one of the two mice exposed to 0.03 mg. Leucocyte counts below 4,400 were not observed in the four mice exposed to 0.01 or 0.03 mg. of radium, and since transient leucocyte counts of from 4,400 to 5,000 were occasionally found in apparently healthy mice, it may be assumed that doses below 0.03 mg. had no effect on the leucocyte level of the blood.

These experiments give no support to the view that small amounts of radium may increase the number of circulating leucocytes in the blood.

EXPOSURE TO GAMMA RAYS OF MICE WITH LYMPHATIC LEUCEMIA CAUSED BY TRANSMISSION

First Series

These experiments were made shortly after isolation of a transmissible strain of lymphatic leucemia (Strain A 35), and the mice lived long enough after the disease had been recognized to permit a study of the effect of continuous exposure to radium on transmitted lymphatic leucemia. The mice were placed in the radium cage as soon as enlargement of spleen and lymph nodes indicated that the inoculation was successful. For almost every lymphomatous mouse that was irradiated there was one set apart as an unirradiated control. Table III shows that the life of leucemic mice was prolonged by irradiation from an average of 19.7 to an average of 26.6 days.

There are many variable factors that influence the duration of illness, of which only one, the virulence of the strain, need be mentioned here. These experiments began soon after the isolation of the strain, when the disease was relatively chronic, but while the experiments were being conducted, the virulence of the strain gradually increased. Hence each group can only be compared with the corresponding controls.

TABLE III

THE EFFECT OF GAMMA RAYS OF RADIUM ON THE LENGTH OF LIFE OF LEUCEMIC MICE (STRAIN A 35)

Amount of radium	No. of mice in group	Length of life after irradiation	
		Average	Variations
mg.		days	days
1	13	29.1	7 to 63
Control	10	18.5	8 to 28
2	9	26.7	14 to 56
Control	9	13.9	2 to 31
1 to 11*	14	24.2	3 to 52
Control	10	24.3	6 to 51
Total:			
Irradiated	36	26.6	3 to 63
Control	29	19.7	2 to 51

* Miscellaneous group; see text.

First the effect of exposure to from 1 to 2 mg. of radium was studied and there was a conspicuous prolongation of life. We then tried exposure to still larger doses of radium, but with little success. This group (the third in Table III) includes four mice which were exposed continuously to 5.8 mg. of radium and died with lymphomatosis from three to fourteen days after ex-

* Since this paper was submitted for publication, two others of the nineteen mice exposed continuously to this amount of radium died with lymphomatosis, and three with tumors; eight mice are still alive.

posure. Another four mice of this group were first exposed to 10 mg. of radium and from two to six days after exposure the amount of radium was decreased to 1 mg., and another four mice were first exposed to 5 mg. of radium and six to fourteen days later the amount of radium was decreased to 1 mg. The following is a brief history of two mice of the third group of Table III.

No. Ax41 had lymphatic leucemia with a leucocyte count of 355,000 immediately before exposure to 10.9 mg. of radium; four days later the leucocyte count was 6,000 and the size of the spleen and lymph nodes had returned to approximately normal. The mouse was transferred to a cage containing 1 mg. of radium and the leucocyte count dropped slowly, reaching 4,200 seven days later. The mouse died twelve days after removal to the 1 mg. cage.

No. Ap65 had a leucocyte count of 21,000 before exposure to 5.8 mg. of radium. On the fourth day of exposure the leucocyte count was 19,000, on the eighth day 13,000, on the fourteenth day 2,800. The amount of radium to which No. Ap65 was exposed was then decreased to 1.02 mg. On the seventh day following this change, its leucocyte count rose to 7,000, on the fifteenth day to 15,000, on the twenty-first day to 114,000, and so on until the day of death of the animal (49 days after exposure to radium) it reached 200,000. The leucocyte counts of the non-irradiated control mouse were 12,000 before exposure of No. Ap65, 40,600 on the fourth day of exposure, 60,000 on the eighth day, and 111,000 on the fourteenth day.

These data show that with the procedure of continuous exposure of lymphomatous mice to radium, a dose of 2 mg. produces more favorable results than a larger dose. Although it is probable that by better adjustment of the dose life may be prolonged more than Table II indicates, it is not probable that the fatal termination of the disease will be prevented. There is apparently no dose that would destroy the malignant lymphocytes of Strain A 35 without causing fatal damage to the host.

Second Series

Approximately one-half year later experimentation with radium was renewed. In the meantime the virulence of the strain had further increased and it was thought advisable to place the mice in the radium cage immediately after inoculation. Table IV summarizes the results of these experiments with continuous irradiation to from 1 to 5 mg. of radium.

TABLE IV

THE EFFECT OF CONTINUOUS EXPOSURE TO RADIUM OF MICE INOCULATED WITH STRAIN A 35

Amount of radium	No. of experiments	No. of mice			Average length of life*
		Injected	+	−	
mg.					days
1	1	3	3	0	7.3
2	5	14	8	6	10
3	3	8	6	2	11.8
5	2	8	6	2	11
Control	5	24	14	10	10.4

+ = inoculation successful; − = inoculation unsuccessful.
* of lymphomatous mice after inoculation.

Since the number of mice in some groups is small, it is desirable to combine two adjacent groups in estimating the percentage of successful inoculations.

Amount of radium	No. of mice injected	Successful injections		Average length of life*
		no.	per cent	
mg.				days
Control	24	14	58.3	10.4
1 to 2	17	11	64.7	9.3
3 to 5	16	12	75	11.4

* of lymphomatous mice after inoculation.

Thus, exposure of mice to radium after inoculation increased the percentage of successful injections, and the length of life of lymphomatous mice continuously exposed to 1 to 2 mg. of radium was somewhat shorter than that of the control mice; mice exposed to 3 to 5 mg. of radium lived somewhat longer than the control mice. It is not probable that doses below 1 mg. would prolong the life of mice inoculated with this strain longer than doses of from 3 to 5 mg.

The unfavorable effect of 1 to 2 mg. of radium reminds us of the unfavorable effect of small doses of roentgen rays, described in the preceding paper. It is doubtful, however, whether the difference in length of life of irradiated and control mice is large enough to be significant. The relatively small percentage of successful inoculations was due to the small inoculating dose employed.

In Table v the effect of continuous exposure of mice with lymphomatosis S 27 to from 1 to 10 mg. of radium is shown. The first part of Table v is the summary of two experiments and shows that 9 to 10 mg. of radium applied during a period of from nine to ten days prolonged life only slightly, and rendered almost all resistant mice susceptible to lymphomatosis S 27. The second part of Table v shows the result of another small experiment in which the life of the inoculated animals was not prolonged by exposure to from 2 to 5 mg. of radium. These doses were sufficient to break down the natural resistance of some animals to this strain.

TABLE V

THE EFFECT OF CONTINUOUS EXPOSURE TO RADIUM OF MICE INOCULATED WITH STRAIN S 27

Amount of radium	No. of experiments	No. of mice			Average length of life*
		Injected	+	−	
mg.					days
Control	2	8	2	6	13.5
9 to 10	2	9	8		15.5
Control	1	9	4	5	14.5
2	1	4	4		12
3	1	2	1	1	15
5	1	2	2		13

One mouse exposed to 9 mg. of radium died of intercurrent disease.

* of lymphomatous mice after inoculation.

Another similar experiment not given in Table v had the following results:

	No. injected	No. +	No. −	No. died of intercurrent disease
Exposed to 2 mg. of radium	6	0	1	5
Exposed to from 3 to 5 mg. of radium	6	0	0	6
Control mice	4	2	1	1

The mice used in these experiments were from three to four months old, and all injections were intravenous. In this experiment, the intercurrent death was due to septicemia caused by *Erythrozoon coccoides*, and it is probable that the material used for inoculation (Strain S 27) was contaminated with this protozoon. The fatal effect of *Erythrozoon* septicemia was in part due to the youth of the animals, but the infection was most severe among the mice exposed to from 3 to 5 mg. of radium.

It is obvious from these experiments that continuous exposure to radium may do more damage by lowering the resistance of the host than good by destroying some malignant lymphocytes.

The results of exposing to radium mice injected subcutaneously with this strain were likewise unfavorable. All three mice exposed for twelve days to 19 mg. of radium died with lymphomatosis after an average period of twelve days. In another experiment, the tumors developing at the site of injection regressed in six of the eight mice exposed to from 2 to 5 mg., but they likewise regressed in two of the four control mice.

TABLE VI

THE EFFECT OF CONTINUOUS EXPOSURE TO RADIUM OF MICE INOCULATED WITH STRAIN Rg 10

Amount of radium	No. of experiments	No. of mice			Average length of life*
		Injected	+	−	
mg.					days
Control	4	16	12	1	20
9 to 10	4	15	13	2	21.2
Control	1	4	2	2	13.7
2 to 3	1	4	3		18.3

Three mice of the first group died of intercurrent disease. In one mouse of the last group the inoculation was of doubtful success.

* of lymphomatous mice after inoculation.

Experiments made with lymphomatosis Rg 10, which has a somewhat longer course, had similar results (Table vi). The first part of this table is the summary of four experiments in which mice were exposed continuously during nine to eleven days to from 9 to 10 mg. of radium, beginning one to seven days after inoculation. Very slight, almost negligible prolongation of life was the result of the radium treatment. The second part of this table records the results of a small experiment in which exposure to

2 to 3 mg. of radium caused moderate prolongation of life.

COMMENTS

The studies described were made with transmissible leucemia and not with the spontaneous disease, and give no decisive information about the latter. Preceding these experiments, thirty-five mice with spontaneous neoplasms were exposed continuously to from 1 to 5 mg. of radium. With the exception of two instances of probably benign papillary adenomata of the breast, all neoplasms continued to grow or recurred if they had been removed before exposure to radium, in spite of the absorption of large quantities of radiant energy, sufficient to cause irreparable damage to the blood-forming organs. Since parallel control experiments with non-irradiated tumor-bearing mice were not made, it is not possible to say if irradiation prolonged the life of the mice with spontaneous neoplasms. Hence, these experiments will not be described in detail.

Spontaneous lymphomatosis may react more favorably to irradiation than transmitted lymphomatosis, and the few experiments we have made with the spontaneous disease encourage further work. One mouse with apparently malignant lymphomatosis lived for 140 days under continuous exposure of from 1 to 2 mg. of radium, and another was removed from the radium cage after an exposure of eighty-four days and died 101 days later. A few other mice with spontaneous lymphomatosis died soon after exposure. These experiments will not be described in detail for they are few in number and do not give sufficient evidence to show that lymphomatosis can be arrested by continuous exposure to radium rays. We have no knowledge of the duration of spontaneous lymphomatosis in mice and cannot always determine with certainty the malignancy of a lymphomatous process in mice from sections of a biopsied lymph node.

In the first volume of the Handbuch of Lazarus,* Einstein discusses changes in the effect of irradiation made by varying the factors of time and intensity, even when the product obtained by multiplying one by the other remains the same. He states that the effect of irradiation depends within certain limits solely upon the quantity of absorbed energy, but assumes that if cancer cells are particularly susceptible to irradiation, long-continued exposure to a given quantity of absorbed energy may be of advantage. However, the difference in susceptibility of malignant cells and certain normal cells essential to life is apparently not great. Moreover, the period of exposure is limited by the rapid multiplication of the malignant lymphocytes, and therefore a relatively large dose is needed to injure them.

CONCLUSIONS

Continuous exposure of mice with transmitted lymphomatosis to gamma rays of radium does not prevent the fatal termination of the disease but often prolongs life. Malignant lymphocytes introduced into healthy mice continue to grow under constant exposure to quantities of irradiation that cause fatal damage to the host.

Gamma rays of radium increase susceptibility of mice to transmitted lymphomatosis.

* Handbuch der gesammten Strahlenheilkunde, München, Vol. 1, 1928, p. 95.

Vol. XXXII, No. 2

PHYSICAL ASPECTS OF VARIOUS QUALITIES OF RADIATION*

By ROBERT S. LANDAUER, Ph.D.
HIGHLAND PARK, ILLINOIS

SINCE the beginning of roentgen therapy to the present time, there has been a discontinuous but nonetheless sure rise in the voltage, and increase in the filter thickness used for this work. Why the continued upward trend in voltage and filter? And where to stop? The roentgenologist has seen voltage increase from a few inches of spark gap to 140,000 volts; from there to 200,000 volts and now to 600,000. Are we going from 600,000 to 6,000,000: why not? The clinician wants more roentgen radiation to the tumor, and the physicist says that to get more roentgen rays to the tumor more voltage must be used.

Possibly the crux of the whole matter, from a strictly physical viewpoint, lies in the fundamental law of photochemistry formulated by Draper, which states that only that radiation which is absorbed produces any chemical action. This law is almost axiomatic in its simplicity if regarded from a standpoint of the law of the conservation of energy. Roentgen rays were unknown at the time of the formulation of the law, but there is no reason whatever for excluding them from the rest of the electromagnetic spectrum, and we may consider the law to hold as well for roentgen rays as for visible or ultraviolet light.

The foundation stone on which we build our entire discussion of How High Voltage is the principle that only that radiation which is absorbed produces any biological action. The second building block is the assumption that the greater the quantity of radiation absorbed, the greater will be the beneficial effect. This assumption is not necessarily true, and of course in many of the common diseases treated with roentgen rays does not hold at all. However, for the treatment of malignancy, and it is for this treatment practically exclusively that we are interested in extremely high voltages, the principle of maximum dosage seems to be rather generally accepted.

This brings us to the question of depth dose, and especially to the question of the possibility of using such hard or such penetrating radiation that we will "shoot through" the lesion without doing it any good. My thesis is that I do not think it is possible to "shoot through" a lesion no matter how hard the radiation, and I believe further that the harder the radiation, the greater the quantity absorbed as we measure it from depth dose measurements.

Here is a simple problem in radiation dosage. I am going to irradiate two similar tumor masses, each of which lies on the surface, and extends 10 cm. deep, with two different qualities of radiation. With the quality used on tumor A, we get a depth dose at 10 cm. of 5 per cent, and with the quality used on tumor B the depth dose at 10 cm. depth is 99 per cent. (Such a quality is not practically obtainable but it is theoretically conceivable.) In other words, let us give the anterior surface of each of the tumors 100 r. The posterior surface received 5 r in one case and 99 r in the other case. Which tumor absorbed more radiation? Did we "shoot through" tumor B? According to an almost universal way of analyzing this problem, and one which I think is entirely erroneous, tumor A absorbed a total of 100−5, or 95 r, while the other absorbed 100−99 or only 1 r. In other words, we shot through tumor B. The radiation was too hard, and lower voltage and filter should have been used. I say that this mode of reasoning is wrong—that we did not "shoot through" the tumor, because what we measured at the posterior surface (99 r) was not the radiation that was coming out but was the radiation

* Read before the Chicago Roentgen Society, November, 1933.

being absorbed at that point. What we measure at the anterior surface of tumor A is that radiation is there being absorbed at the rate of 100 r per minute, and at the posterior surface at the rate of 5 r per minute. Tumor B is absorbing at the rate of 100 r per minute at the anterior surface and at the rate of 99 r per minute at the posterior surface. Our measuring instruments do not measure what is going through—they measure only that which is being absorbed. We cannot possibly measure that which is going through, because according to Draper's law that which is transmitted has no chemical action, and if it has no effect on tissue, it can have no effect on an ionization chamber. We must consider depth dose, not as that fraction of surface quantity reaching a given point, but as a definite quantity being absorbed at a definite point. Let me state a correct and an incorrect mechanical analogy. Let us first think of a single bullet being shot from a gun and penetrating a thick block of soft wood. Consider its kinetic energy when it strikes the wood as 100 units, and its energy when it is 10 cm. deep as 5 units. This bullet has given up to the wood 100 − 5, or 95 units of kinetic energy. This is *not* what happens when roentgen rays pass through matter as we measure them. Consider the second analogy. Let us think of a vast stream of bullets being fired from a machine gun. Out of this vast stream, 100 bullets are stopped at the surface of the wood, and give up, at that point, 100 units of kinetic energy. The stream of bullets continues on through the wood, and at a point 10 cm. deep we find 5 more bullets being stopped, giving up their 5 units of energy, making a total absorbed of 105 units. This is what happens when we measure a 5 per cent depth dose, considering only the absorption at the surface layer and at the 10 cm. depth layer. What do we have if we have a 99 per cent depth dose? In this case 100 bullets are absorbed at the surface and 99 more absorbed at the 10 cm. depth, giving a total absorption of 199 bullets. Let me reiterate that what we measure, wherever we measure it, is the number of bullets being stopped—not the number passing through. We do not measure the total energy of the roentgen beam at the surface, we measure only that fraction of the beam which is there being absorbed. To get back to our problem of the tumors, the above shows that tumor B with its 99 per cent depth dose absorbed a far greater quantity of radiation than did tumor A with its 5 per cent depth dose, although one might readily think otherwise. We did not shoot through tumor B. I think that this is a rather new way of thinking of depth dose but it must be the correct way. A 60 per cent depth dose means that 60 per cent as much energy is being absorbed at 10 cm. depth as is being absorbed at the surface, not that 60 per cent of the skin dose is escaping through the "back door" and is not being used.

From a clinical standpoint, this lack of possibility of "shooting through" a lesion is borne out by the routine use of heavily filtered radium or radon in the treatment of superficial skin lesions. Here we have a radiation far more penetrating than the hardest roentgen rays being used for the treatment of a lesion only a centimeter or so thick. Even in the treatment of superficial non-malignant diseases such as acne and eczema many roentgenologists use relatively high voltage with filter.

The conclusion to which this leads is that to fulfill the fundamental requirement of greatest possible absorption we want the greatest possible depth dose. To get this greatest possible depth dose, we must use the greatest possible voltage to produce the radiation. So, from a strictly physical standpoint, the answer to our problem is not 200,000 or 400,000 or 600,000 volts, but just as high a voltage as we can get.

It should be noted that this advocacy of an extremely high voltage is based solely on the premise that through its use more radiation will be absorbed at the point where it is desired. It does not take into account any possible differences in the bio-

logical action of the different qualities of radiation, nor does it take into account the economic consequences.

After having concluded that we want high voltage let us see from a quantitative angle just what the techniques which we have at present available will do for us. I am going to consider five different qualities of radiation:

Quality	Voltage	Filter
1	100 kv. peak	0
2	140 kv. peak	0.25 mm. Cu+1 mm. Al
3	200 kv. peak	0.5 mm. Cu+1 mm. Al
4	600 kv. peak	5.0 mm. Cu
5	Radium (3,000,000)	1.0 mm. Pt

With these five qualities we get an increasing depth dose as the quality number increases:

Quality	Depth Dose at 10 cm. per cent
1	5
2	25
3	45
4	55
5	14

For qualities 1 to 4, inclusive, the skin target distance is 50 cm. For quality 5 (radium bomb) the distance is only 6 cm. This of course accounts for the low value. Obviously, an increase in voltage and filter gives greater depth dose and consequently greater absorption at the depth per unit dose given to the skin.

There is possibly another important factor in the quantitative determination of total dosage and that is the question of apparent increase of skin tolerance or threshold erythema with harder and harder radiation. It has been generally noticed clinically that with increase of voltage and filter a greater number of roentgens may be administered to the skin to produce the same biological effect. However, there is another factor than hardness which is a function of this increase of voltage and filter, and that is the rate of administration of the radiation. In general, the harder the radiation, the lower the roentgen-ray output in roentgens per minute. (The reason for this lies principally in the physical limitations of our present-day generators and tubes.) The lower the r output per minute, the slower will be the rate of administration. Packard claims that it is this effect entirely that accounts for the apparently greater skin tolerance to hard radiation, and that if equal doses of hard and soft radiation be administered in equal times, the biological effect will be the same. On the other hand, Failla believes that under certain conditions the effects of equal quantities of radiation of different wave lengths are different. Without attempting to decide whether the increased tolerance is due to a definite dependence on wave length, or whether it is due to some concomitant effect, we may say that roentgenologists have, in general, given larger doses of radiation as the voltage and filter have been increased. The number of r generally considered necessary to produce a threshold erythema with different qualities is somewhat as follows:

Quality	r to Produce Erythema
1	350
2	500
3	800
4	1,300
5	2,000

Combining the table of depth doses with the above table of number of r necessary to produce an erythema, we find that without damage to the skin, a point in a tumor 10 cm. deep may be given (absorbs) at one time and through a single portal, the following dose:

Quality	Dose in r
1	17.5
2	125
3	340
4	715
5	280

The above figures are interesting, especially the values for quality 5 (radium bomb). It must be remembered that these figures are taken from actual working conditions and not from theoretically equal ex-

periments. For example, the depth dose from quality 5 would be greater than that from quality 4 if the determinations had been made at equal distances. However, since the radium bomb is actually used at 6 cm., it is the values at this distance in which we are really interested. If, as is sometimes the case, the radium bomb is used at a 15 cm. distance, the depth dose increases to 18 per cent, and the dose to the tumor increases to 360 r.

A comparison of the radium bomb with quality 3 (200 kv. peak, 0.5 mm. Cu) is interesting. At 200 kv. peak with 0.5 mm. Cu + 1 mm. Al filter, 5 ma. and 50 cm. distance, the roentgen-ray output of the mechanically rectified roentgen-ray machine at Michael Reese Hospital in Chicago, is 10.7 r per minute measured in air. To administer 340 r to the tumor would require 800 r to the skin (erythema dose), or a treatment time of seventy-five minutes. The gamma-ray output of the radium bomb (4 grams) at the same hospital, at a distance of 6 cm. is 10.9 r per minute. To administer 280 r to the tumor would require 2,000 r to the skin (erythema dose) with a time of 183 minutes. Thus, quality 3 administers 21 per cent more radiation in 38 per cent of the time required for the radium bomb. To put the radium bomb on an equivalent basis to the 200,000 volt roentgen machine would require 12 grams of radium, which at a price of $60.00 per milligram would cost the sum of $720,000.

Quality 4, namely, 600,000 volts, comes nearest to giving the dosage which we feel should be given. I am informed that the high voltage machine at Mercy Hospital in Chicago delivers 23 r per minute. At this rate 715 r could be administered to the tumor in fifty-five minutes, a far superior amount in considerably less time than with 200 kv. peak, and much better than with the radium bomb.

Quality 5 (radium bomb) under certain conditions could be made to give a depth dose of nearly 65 per cent. This would mean a tumor dose per single port of 1,300 r. However, to do this, the radium would need be 40 cm. from the patient and the quantity necessary to keep the treatment time within reasonable bounds would have to be enormous—somewhere in the neighborhood of 180 grams, which would cost $10,600,000.

The conclusion which we reach is that as voltage and filter increase the total tumor dose per single skin area increases. This increase is brought about by the combined action of two causes: one, the increased depth dose regarding which physical measurements admit of no discussion (except as to small disagreements between different observers) and the second the increased skin tolerance to harder radiation which is not yet definitely settled biologically. If Packard's views are correct, and just as large doses can be administered with soft as with hard radiation, then this second factor disappears, and leaves the only advantage to be gained from high voltage that due to increased depth dose. This biological uncertainty leaves unchanged, however, the primary thesis of this paper, namely, that to give the greatest possible quantity of radiation to a tumor, the highest possible voltage must be used.

I have stated my views that, from a physical standpoint, voltage and filter may be considerably increased, possibly far beyond the 600,000 volts now being used. From the economical standpoint there is, of course, a practical limit. At present, the relative costs to obtain qualities 3, 4 and 5 is somewhat in the ratio of $3,000 to $70,000 to $250,000. Before much of qualities 4 and 5 are used, I feel that, in addition to the physicist's prediction of increased physical dosage, must come the clinician's definite verification of better clinical results. Otherwise the cost is too great.

I wish to thank Dr. Robert Arens for his courtesy in extending to me the facilities of the Roentgen Department of Michael Reese Hospital, where some of the measurements were made, and also to Dr. Max Cutler of the same hospital for the use of the 4 gram radium bomb.

Vol. XXXII, No. 2

THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

Editor: Lawrence Reynolds, M.D.
Assistant Editor: Ruth Bigelow, B.S.
Editorial Board: A. C. Christie, M.D. E. H. Skinner, M.D. Lauriston S. Taylor
Advisory Board for Pathology: James Ewing, M.D. Eugene L. Opie, M.D.
Collaborating Editors: The Offices and Committee Members of the Societies of which this Journal is the official organ, whose names appear on this page, are considered collaborating editors of this Journal.
Foreign Collaborators: A. Béclère, M.D., Paris, Gösta Forssell, M.D., Stockholm, G. F. Haenisch, M.D., Hamburg, R. Ledoux-Lebard, M.D., Paris.

Publisher: Charles C Thomas, 220 East Monroe St., Springfield, Illinois.

Issued Monthly. Subscription $10.00 per year, $11.00 in Canada and $12.00 in foreign countries. Advertising rates submitted on application: Editorial office, 110 Professional Building, Detroit, Mich. Office of publication, 220 E. Monroe St., Springfield, Ill. Information of interest to all readers will be found on page iv.

Officers and Standing Committees

THE AMERICAN ROENTGEN RAY SOCIETY

President: John T. Murphy, Toledo, Ohio; *President-Elect:* George W. Grier, Pittsburgh, Pa.; *1st Vice-President:* L. R. Sante, St. Louis, Mo.; *2d Vice-President:* H. J. Walton, Baltimore, Md.; *Secretary:* E. P. Pendergrass, University Hospital, Philadelphia, Pa.; *Treasurer:* E. L. Jenkinson, 1439 S. Michigan Ave., Chicago, Ill.; *Historian:* E. H. Skinner, Kansas City, Mo.

Executive Council: John T. Murphy, George W. Grier, L. R. Sante, H. J. Walton, E. P. Pendergrass, E. L. Jenkinson, Lawrence Reynolds, J. Bennett Edwards, B. R. Kirklin, L. Jaches, W. A. Evans, Charles L. Martin, Sherwood Moore, Merrill C. Sosman, Chairman, Peter Bent Brigham Hospital, Boston, Mass.

Committee on Relationship between Radiologists and Hospitals: L. Jaches, Chairman, New York, A. C. Christie, Washington, D.C., W. C. Hill, Cleveland, Ohio.

Committee on Safety and Standards: A. U. Desjardins, Chairman, Rochester, Minn., T. Leucutia, Detroit, Mich., W. D. Coolidge, Schenectady, N.Y., G. E. Richards, Toronto, Ont., F. J. Hodges, Ann Arbor, Mich., H. K. Pancoast, Philadelphia, Pa.

Publication Committee: B. R. Kirklin, Chairman, Rochester, Minn., Ross Golden, New York City, Ralph S. Bromer, Bryn Mawr, Pa.

Finance Committee: J. Bennett Edwards, Chairman, Leonia, N. J., Leslie R. Hess, Hamilton, Ont., Raymond C. Beeler, Indianapolis, Ind.

Advisory Committee to the Moore School X-ray Laboratory: W. E. Chamberlain, Chairman, Philadelphia, R. R. Newell, San Francisco, E. P. Pendergrass, Philadelphia.

Representatives on The American Board of Radiology: B. R. Kirklin, Rochester, Minn., L. R. Sante, St. Louis, Mo., W. F. Manges, Philadelphia, Pa.

Member, National Research Council: M. C. Sosman, Boston, Mass.

Committee on Arrangements: R. B. Robinson, Chairman, Jenkins Arcade, Pittsburgh, Zoe A. Johnston, Heinz Langer, J. F. McCullough, W. B. Ray, J. W. Fisher, C. S. Caldwell.

Editor: Lawrence Reynolds, 110 Professional Building, Detroit, Mich.

Assistant Editor: Ruth Bigelow, 110 Professional Building, Detroit, Mich.

Editorial Board: A. C. Christie, E. H. Skinner, Lauriston S. Taylor.

Advisory Board for Pathology: James Ewing, Eugene L. Opie.

Thirty-fifth Annual Meeting: Hotel Wm. Penn, Pittsburgh, Pa., Sept. 25–28, 1934.

THE AMERICAN RADIUM SOCIETY

President: Rollin H. Stevens, Detroit, Mich.; *President-Elect:* William H. Cameron, New York City; *1st Vice-President:* George W. Grier, Pittsburgh, Pa.; *2d Vice-President:* John W. Cathcart, El Paso, Texas; *Secretary:* Edward H. Skinner, 1532 Professional Bldg., Kansas City, Mo.; *Treasurer:* Zoe H. Johnston, Jenkins Arcade, Pittsburgh, Pa.

Executive Committee: H. J. Ullmann, Chairman, Santa Barbara, Calif., Sanford Withers, Denver, Colo., E. C. Ernst, St. Louis, Mo.

Program Committee: Wm. H. Cameron, Chairman, New York City, Maurice Lenz, New York City, J. E. Gendreau, Montreal, Que.

Publication Committee: E. H. Skinner, Chairman, Kansas City, Mo., B. F. Schreiner, Buffalo, N.Y., Douglas Quick, New York City.

Research and Standardization Committee: G. Failla, Chairman, New York, H. J. Ullmann, Santa Barbara, Calif., R. B. Greenough, Boston, Mass.

Education and Publicity Committee: G. E. Pfahler, Chairman, Philadelphia, Pa., C. L. Martin, Dallas, Texas, J. S. Ullman, Natchez, Miss.

Representatives on The American Board of Radiology: Henry Schmitz, Chicago, R. H. Stevens, Detroit, H. K. Pancoast, Philadelphia.

20th Annual Meeting: Atlantic City, N.J., 1935.

EDITORIALS

THE ANNUAL MEETING

THE Thirty-fifth Annual Meeting of the American Roentgen Ray Society will be held in Pittsburgh, September 25 to 28, 1934, at the Hotel William Penn, under the presidency of Dr. George W. Grier. Elsewhere in the Journal will be found the preliminary program of the meeting which Dr. Grier and his committee have arranged. A perusal of this program is sufficient to assure the members of the Society and their guests that this is no Barmecide feast that is being set before them, as the program includes a variety of topics of great current interest and importance. The meeting last year was held in conjunction with the three other roentgen ray and radium societies during the time of the Century of Progress, as the first American Congress of Radiology. That was a very stimulating and instructive meeting as it gathered together the largest body of radiologists which has ever assembled in this country. This year the American Roentgen Ray Society, as do the others, reverts to its usual custom of an individual meeting.

This year's meeting is of extreme importance to the members of the Society by virtue of the fact that not only is the program of sufficient interest to justify the journey to Pittsburgh but the economic situation which confronts radiologists in their relation to medicine in general and to the public welfare will be discussed and the Society's attitude toward these important questions will be determined.

In addition to the scientific sessions there will be scientific exhibits of a breadth and importance to stimulate the interest of all those in attendance, and now that we are emerging somewhat from the depression the commercial exhibitors will display the developments and the inventions upon which they have been working during the lean years through which we have just passed.

As will be noted from the program, the evening entertainments which have been arranged should prove of no less interest than the scientific program. On Tuesday evening the Caldwell Lecture will be given by Dr. Walter B. Cannon of the Harvard Medical School. Dr. Cannon's achievements are well known to all roentgenologists. On Wednesday afternoon a picnic has been planned and on Thursday evening the Annual Dinner will be held.

As a further earnest of the quality of the meeting, the arrangements at the Hotel William Penn are such as to care for the Society's scientific sessions and exhibits in an ideal manner; the meeting and exhibit halls are on the same floor and in addition there are ample accommodations for the entire membership of the Society. The meeting being held in Pittsburgh where the railroad facilities are excellent from all parts of the country justifies the hope and expectation that there will be a splendid attendance. No member of the Society can afford to miss the Pittsburgh meeting as it will undoubtedly be one of the important meetings in the Society's history.

"SHOOTING THROUGH" WITH ROENTGEN RAYS?

IN HIS article dealing with certain physical aspects of roentgen rays, published in this month's journal, Dr. Landauer has given a clear and correct analysis of the puzzling problem of "shooting through" a tissue. The very common view, that the roentgen-ray energy absorbed is measured by the *difference* in roentgens above and below the tissue which is irradiated, is based upon the misconception that the roentgen is a unit of roentgen-ray energy falling upon a surface. As it is defined and measured, the roentgen is instead a unit of ionization, that is, of *energy absorbed*. This means that if the dose is measured in r, we are measuring the roentgen rays absorbed per cubic centimeter of air, which is at least very nearly proportional to the roentgen rays absorbed per cubic centimeter in the adjacent tissue. Thus, if the ionization meter reads 100 r at the upper surface of the tissue and 80 r at its lower surface, the true meaning is that at the upper surface the dose is 100 r, and below it is 80 r. The dose is *not* (100–80)r. The physics of the problem is clear: when measured in roentgens (units of ionization or absorbed energy), roentgen rays, however hard, cannot "shoot through" a tissue without leaving their effect.

Dr. Landauer is to be congratulated for having presented this lucid analysis of the problem.

ARTHUR H. COMPTON

CARLOS HEUSER
1878–1934

DR. CARLOS HEUSER, an international figure in radiology, died in Buenos Aires on March 28, 1934, at the age of fifty-six. He was born in Buenos Aires and pursued his primary and secondary studies in that city. He graduated from the medical school in 1902, his thesis having been awarded the gold medal. From that early date he dedicated himself to the study of radiology. He contributed many improvements to its technique and wrote many articles, published, for the most part, first in *La prensa médica argentina*, as well as several books on radiology. Among these were a practical treatise on radiology and superficial and deep radiotherapy for which he received the prize of the Faculty of Medicine of Buenos Aires. He also wrote a book on the use of the x-ray in gynecology, obstretrics, and urology; numerous articles on arteriography, hepatolienography, amniography, intravenous pyelography, and many articles on hydatid cysts both from the standpoint of diagnosis and treatment, the diagnosis of pregnancy in the early months by means of the roentgen ray, etc. Apparently, Dr. Heuser was the first to use lipiodol for uterosalpingography, having accomplished this in 1921, and wrote many articles dealing with this subject. Dr. Heuser took part in numerous international congresses, and in 1930 received the gold medal of the Radiological Society of North America. He was a corresponding member of the American Roentgen Ray Society, and an honorary member of the American College of Radiology.

JAMES T. CASE

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Items for this section solicited promptly after the events to which they refer.

MEETINGS OF ROENTGEN SOCIETIES*

United States of America

American Roentgen Ray Society
Secretary, Dr. E. P. Pendergrass, University Hospital, Philadelphia, Pa.
Annual Meeting: Hotel William Penn, Pittsburgh, Pa., Sept. 25–28, 1934.

American College of Radiology
Secretary, Dr. Albert Soiland, 1407 S. Hope St., Los Angeles, Calif.
Annual meeting: Atlantic City, N.J., 1935.

Section on Radiology, American Medical Association
Secretary, Dr. J. T. Murphy, 421 Michigan St., Toledo, Ohio.
Annual meeting: Atlantic City, N.J., 1935.

Radiological Society of North America
Secretary, Dr. D. S. Childs, 607 Medical Arts Bldg., Syracuse, N.Y.
Annual meeting: Memphis, Tenn., Dec. 3–7, 1934.

Radiological Section, Baltimore Medical Society
Secretary, Dr. W. B. Firor, 1100 N. Charles St., Baltimore.
Meets third Tuesday each month, September to May.

Radiological Section, Los Angeles County Medical Society
Secretary, E. N. Liljedahl, Los Angeles, Calif.
Meets on the third Wednesday of each month at the California Hospital.

Radiological Section, Southern Medical Association
Secretary, Dr. F. B. Bogart, Medical Arts Bldg., Chattanooga, Tenn.
Annual meeting: San Antonio, Texas, November, 1934.

Brooklyn Roentgen Ray Society
Secretary, Dr. A. L. Voltz, 115 Myrtle Ave., Richmond Hill, N.Y.
Meets monthly on first Tuesday, October to April.

Buffalo Radiological Society
Secretary-Treasurer, Dr. Joseph S. Gian-Franceschi, 610 Niagara St., Buffalo, N.Y.
Meets second Monday of each month except during summer months, place of meeting selected by the host.

Chicago Roentgen Society
Secretary, Dr. R. G. Willy, 1138 N. Leavitt.
Meets second Thursday of each month October to May inclusive at the Palmer House.

Cincinnati Radiological Society
Secretary, Dr. H. G. Reineke, General Hospital, Cincinnati, Ohio.
Meets third Monday of each month, October to May, inclusive.

Cleveland Radiological Society
Secretary, Dr. Otto Glasser, Cleveland Clinic.
Meetings are held at 6:30 P.M. at the Cleveland Chamber of Commerce Club rooms on the fourth Monday of each month from October to April, inclusive.

Detroit Roentgen Ray and Radium Society
Secretary, Dr. E. R. Witwer, Harper Hospital.
Meets monthly on first Thursday from October to May, at Wayne Country Medical Society Building.

Florida Radiological Society
Secretary, Dr. W. McL. Shaw, 418 St. James Bldg., Jacksonville, Fla.
Meetings held twice a year, May and November.

Illinois Radiological Society
Secretary, Dr. H. W. Grote, 219 N. Main St., Bloomington, Ill.
Regular meetings held quarterly.

Indiana Roentgen Society
Secretary, Dr. J. N. Collins, Indianapolis, Ind.
Annual meeting each February 22 in Indianapolis.

Michigan Association of Roentgenologists
Secretary, Dr. S. W. Donaldson, St. Joseph's Mercy Hospital, Ann Arbor, Mich. Three meetings a year, Fall, Winter, and Spring.

Milwaukee Roentgen Ray Society
Secretary, Dr. S. A. Morton, Columbia Hospital, Milwaukee, Wis.
Meets monthly. Place of meeting designed by the president.

Minnesota Radiological Society
Secretary, Dr. L. G. Rigler, University Hospital, Minneapolis, Minn.

New England Roentgen Ray Society
Secretary, Dr. Thomas R. Healy, 370 Marlboro St., Boston Mass.
Meets monthly on third Friday, Boston Medical Library.

Radiological Society of New Jersey
Secretary, Dr. P. S. Avery, New Brunswick, N. J.
Meets annually at time and place of State Medical Society. Mid-year meetings at place designated by the president.

New York Roentgen Society
Secretary, Dr. C. W. Schwartz, 33 E. 68th St., New York.
Meets monthly on third Monday, New York Academy of Medicine, at 8:30 P.M.

North Carolina Roentgen Ray Society
Secretary, Dr. Major Fleming, Rocky Mount, N.C.
Annual meeting at time and place of State Medical Society. Mid-year scientific meeting at place designated.

Central New York Roentgen Ray Society
Secretary, Dr. F. C. Rulison, Medical Arts Bldg., Syracuse, N.Y.
Three meetings a year—January, May, and November.

Pacific Roentgen Club
Secretary, Dr. L. H. Garland, 450 Sutter St., San Francisco, Calif.
Meets annually, during meeting of California Medical Association

Pennsylvania Radiological Society
Secretary, Dr. L. E. Wurster, Williamsport, Pa.
Annual two-day meeting held during May. 1935 meeting, to be announced.

Philadelphia Roentgen Ray Society
Secretary, Dr. Thomas Loughery, Germantown Hospital.
Meeting first Thursday of each month from October to May inclusive, at 8:15 P.M., in Thompson Hall, College of Physicians, 19 S. 22d St.

Rochester Roentgen Ray Society, Rochester, N.Y.
Secretary, Dr. W. W. Fray, Strong Memorial Hospital.
Meets monthly on second Thursday from October to May, inclusive, at 7:45 at the Rochester Medical Association Building.

St. Louis Roentgen Club
Secretary, Dr. W. K. Mueller, University Club Bldg.
Meets first week of each month. Time and place of meetings designated by president.

South Carolina X-Ray Society
Secretary, Dr. R. B. Taft, 105 Rutledge Ave., Charleston.
Meets at time and place of South Carolina State Medical Association.

* Secretaries of Societies not here listed are requested to send the necessary information to the Editor.

Tennessee Radiological Society
Secretary, Dr. F. B. Bogart, 311 Medical Arts Bldg., Chattanooga, Tenn.
Meets annually at the time and place of the Tennessee State Medical Association.

Texas Radiological Society
Secretary-Treasurer, Dr. J. H. Smith, Lubbock, Texas.
Meets annually one day preceding the meeting of the Texas State Medical Association.

University of Michigan Department of Roentgenology Staff Meeting.
Secretary, Dr. C. B. Pierce, University Hospital, Ann Arbor, Mich.
Meets each Monday evening from September to June, at 7 P.M. at University Hospital.

University of Wisconsin Roentgen Club
Secretary, Dr. E. A. Pohle, 1300 University Ave., Madison, Wis.
Meets monghly on last Thursday, October to April, Service Memorial Institute, at 4:30 P.M.

Virginia Roentgen Ray Club
Secretary, Dr. V. W. Archer, University Hospital, University, Va.
Meets annually in October.

Cuba

Sociedad Cubana de Radiologia y Fisioterapia
Secretary, Dr. Luis Fariñas, Animas 110, Havana, Cuba.
Meets monthly in Havana.

British Empire

British Institute of Radiology Incorporated with the Röntgen Society
Meets on the third Thursday of each month, from November to June inclusive, at 8:15 P.M., at 32 Welbeck St. London, W. 1., or as advertised.

Electro-Therapeutic Section of the Royal Society of Medicine (Confined to Medical Members)
Meets on the third Friday of each month during the winter at 8:30 P.M. at the Royal Society of Medicine, 1 Wimpole St., London, W. 1.

Section of Radiology and Medical Electricity, Australasian Medical Congress
Secretary, Dr. H. M. Cutler, 139 Macquarie St., Sydney, New South Wales.

Radiological Section of the Victorian Branch of the British Medical Association
Secretary, Dr. Douglas Thomas, 12 Collins St., Melbourne, Australia.
Meets monthly at Melbourne from March to December.

Section on Radiology, Canadian Medical Association
Secretary, Dr. A. H. Rolph, 160 St. George St., Toronto, Ont.

Indian Radiological Association
Secretary, Sd. Subodh Mitra, 148 Russa Rd., Calcutta.
Meets annually in January and at such places and times as the Council may appoint.

Radiological Section, New Zealand British Medical Association
Secretary, Dr. P. C. Fenwick, The Hospital, Christchurch. Meets annually.

Continental Europe

Belgian Society of Roentgenology
Secretary, Dr. J. Boine, Avenue des Allies, 134, Louvain, (Belgian).
Meets monthly on second Sunday at d'Egmonds Palace, Brussels, except in the summer time.

Société de Radiologie Médicale de France
Meets monthly on second Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

Société Suisse de Radiologie (Schweizerische Röntgen-Gesellschaft)
Secretary for French language, Dr. A. Grosjean, La Chaux de Fonds.
Secretary for German language, Dr. Scheurer, Molzgasse, Biel.
Meets annually in different cities.

Société Française d'Electrothérapie et de Radiologie Médicale
Meets monthly on fourth Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

Association of German Roentgenologists and Radiologists in Czecho-Slovakia
Secretary, Dr. Walter Altschul, German University, Prague, 11/52.

Deutsche Röntgen-Gesellschaft (Gesellschaft für Röntgenkunde und Strahlenforschung)
Meets annually in April in different German cities, at least once in five years in Berlin. Meets in addition every two years with the Gesellschaft deutscher Naturforscher und Aerzte.
Permanent Secretary, Professor Dr. Haenisch, Klopstockstrasse 10, Hamburg, Germany.

Dutch Society of Electrology and Roentgenology
Holds two meetings a year in Amsterdam, one in the Spring, and one in the Fall.

Societa Italiana Radiologia Medica
Secretary, Professor M. Ponzio, University of Turin, Turin.

Societatea Romana de Radiologie si Electrologie
Secretary, Dr. Oscar Meller, Str. Banul Maracine 30, Bucharest, Rumania.
Meets second Monday in every month with the exception of July and August.

All-Russian Roentgen Ray Association, Leningrad, USSR, in the State Institute of Roentgenology and Radiology, 6 Roentgen St.
Secretaries, Drs. S. A. Reinberg and S. G. Simonson.
Meets annually.

Leningrad Roentgen Ray Society
Secretaries, Drs. S. G. Simonson and G. A. Gusterin.
Meets monthly, first Monday at 8 o'clock, State Institute of Roentgenology and Radiology, Leningrad.

Moscow Roentgen Ray Society
Secretaries, Drs. L. L. Holst, A. W. Ssamygin and S. T. Konobejevsky.
Meets monthly on the first Monday at 8 o'clock, the place of meeting being selected by the Society.

Polish Society of Radiology
Secretary, Dr. Jan. Kochanowski, 45 Gornoslazka St., Warsaw.
Meets annually.

Warsaw Section, Polish Society of Radiology
Secretary, Dr. B. Krynski, 11 Zielna St.
Meets once a month except in the summer time.

Scandinavian Roentgen Societies
The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association. Each of the following societies, with exception of the Denmark Society, meets every second month except in the summer time.

Society of Medical Radiology of Sweden
Meets in Stockholm.

Society of Medical Radiology in Norway
Meets in Oslo.

Society of Medical Radiology in Denmark
Secretary, Dr. H. Schuermann, Copenhagen.
Meets on the second Wednesday of each month from October to July in Copenhagen, at 8 o'clock in the State Institute of Roentgenology.

Society of Medical Radiology in Finland
Meets in Helsingfors.

Vienna Society of Roentgenology
Meets first Tuesday each month, October to July.

Orient

Japan X-Ray Association
c/o Orthopedic Surgery, Tokyo Imperial University.
Meets annually in April.

Kinki Roentgen-Abend Society
Director, Dr. Prof. Taiga Saito, Ogawaoike, Kyoto, Japan.
Meets bi-monthly on third Sunday.

SCIENTIFIC PROGRAM

OF THE

THIRTY-FIFTH ANNUAL MEETING

OF THE

AMERICAN ROENTGEN RAY SOCIETY, SEPTEMBER 25–28, 1934
HOTEL WILLIAM PENN, PITTSBURGH, PENNSYLVANIA

Tuesday Morning, September 25, 1934

9:00 A.M.

Call to Order. John T. Murphy, M.D.

Retiring President's Address. John T. Murphy, M.D.

Installation of in-coming President.

Announcements.

President's Address. George W. Grier, M.D.

9:30 A.M.

Roentgen therapy in thrombo-angiitis obliterans. George E. Pfahler, M.D., Philadelphia, Pa.

Symposium

1. Observations on the use of 300,000 volts in treatment. John T. Murphy, M.D., Toledo, Ohio.
2. Results of the use of 300,000 volts in treatment. J. E. Gendreau, M.D., Montreal, Canada. (By invitation.)
3. X-ray therapy with the higher voltages. Ralph E. Herendeen, M.D., New York City.
4. High voltage x-ray protection. Lauriston S. Taylor, Washington, D.C.
5. Problems of field distribution with very high voltage roentgen tubes. T. Leucutia, M.D., and K. E. Corrigan, Ph.D. (by invitation), Detroit, Mich.

Tuesday Afternoon, September 25, 1934

2:00 P.M.

The effect of x-ray therapy upon mixed tumors of the kidney in children. Albert E. Bothe, M.D., Philadelphia, Pa. (By invitation.)

What can be accomplished by the preoperative irradiation of cortical renal tumors. C. A. Waters, M.D., Baltimore, Md.

Mortality studies in treated cancers of the cervix. Robert E. Fricke, M.D., Rochester, Minn.

Further observations on the use of unfiltered roentgen rays for superficial cancers of wide and deep involvement. Bernard P. Widmann, M.D., Philadelphia, Pa.

Neoplasms of the mouth and upper respiratory tract treated by protracted roentgen therapy (Coutard unmodified). William Harris, M.D., New York City.

Our changing conceptions regarding the skin dose with some notes on the production of epidermolysis. Walter L. Mattick, M.D., Buffalo, N.Y. (By invitation.)

4:30 P.M. Executive Session

Tuesday Evening, September 25, 1934

8:00 P.M.

Caldwell Lecture. Walter B. Cannon, M.D., Harvard Medical School, Boston, Mass.

Wednesday Morning, September 26, 1934

9:00 A.M.

Tuberculosis in children. F. M. McPhedran, M.D., Philadelphia, Pa. (By invitation.)

Diagnosis and surgical treatment of intrathoracic tumors. S. W. Harrington, M.D., Rochester, Minn. (By invitation.)

Roentgen examination of the chest after operation. John W. Pierson, M.D., Baltimore, Md.

Serial bronchography in the diagnosis of pulmonary suppurative processes. Pedro L. Farinas, M.D., Havana, Cuba.

Fusospirochetal pneumonia. Carleton B. Peirce, M.D., and Henry Field, Jr., M.D. (by invitation), Ann Arbor, Mich.

Hard-hearted people from the roentgenologist's viewpoint. M. C. Sosman, M.D., Boston, Mass.

Wednesday Afternoon, September 26, 1934

2:00 P.M.

The roentgenologist as an expert medical witness. William A. Evans, M.D., Detroit, Mich.

Demonstration of the mucosa of the gastrointestinal tract with compression technique. George W. Holmes, M.D., and Richard Schatzki, M.D. (by invitation), Boston, Mass.

3:30 P.M. Picnic

THURSDAY MORNING, SEPTEMBER 27, 1934

9:00 A.M.

Congenital anomalies of the alimentary tract. Willis F. Manges, M.D., and Louis H. Clerf, M.D. (by invitation), Philadelphia, Pa.

Cancer of the stomach. Ross Golden, M.D., and A. Purdy Stout, M.D. (by invitation), New York City.

Sarcoma of the stomach: Case report. Robert Drane, M.D., Savannah, Ga.

Roentgenologic determination of normal and abnormal results following operations on the stomach and duodenum. B. R. Kirklin, Rochester, Minn.

Intestinal obstruction. L. R. Sante, M.D., St. Louis, Mo.

Roentgen diagnosis of aneurysms of the innominate artery. C. H. Warfield, M.D., Chicago, Ill. (By invitation.)

THURSDAY AFTERNOON, SEPTEMBER 27, 1934

2:00 P.M.

Symposium

1. Encephalography. Bernard H. Nichols, M.D., Cleveland, Ohio.
2. Anatomy of the brain studied by encephalography, C. G. Dyke, M.D., and Leo M. Davidoff, M.D. (by invitation), New York City.
3. Reliability of brain tumor localization by roentgen methods. Fred J. Hodges, M.D., and Vincent C. Johnson, M.D. (by invitation), Ann Arbor, Mich.
4. The responsibility of the roentgenologist in the detection of intracranial tumors. Karl Kornblum, M.D., Philadelphia, Pa.

Suppurative lesions in the petrosal pyramid. Henry K. Taylor, M.D., New York City.

The relationship between ethmoiditis and ocular disturbances. S. L. Koch, M.D. (by invitation), and J. Homer McCready, M.D. (by invitation), Pittsburgh, Pa.

4:30 P.M. EXECUTIVE SESSION

THURSDAY EVENING, SEPTEMBER 27, 1934

7:00 P.M. ANNUAL DINNER

FRIDAY MORNING, SEPTEMBER 28, 1934

9:00 A.M.

Diagnosis of traumatic lesions of the urinary tract with special reference to the value of excretory urography. Frederick O. Coe, M. D., Washington, D.C.

Cortical abscess and renal carbuncle: A clinical and roentgenological study. Leopold Jaches, M.D., and Marcy L. Sussman, M.D. (by invitation), New York City.

The advantages of intensified cholecystography. William H. Stewart, M.D., New York City.

Cholecystographic diagnosis of gallbladder papillomas and tumors. Claude Moore, M. D., Washington, D.C.

Modification of radiosensitivity by means of readily penetrating acids and bases. R. Zirkle, M.D., Philadelphia, Pa. (By invitation.)

Roentgen therapy for hyperplastic blood dyscrasias: New technique of roentgen therapy for myeloid and lymphatic leukemia, polycythemia rubra vera and Hodgkin's disease. Heinz Langer, M.D., Pittsburgh, Pa.

FRIDAY AFTERNOON, SEPTEMBER 28, 1934

2:00 P.M.

The biological measurement of intensity of different wave lengths of radiation. Paul S. Henshaw, Ph.D., New York City. (By invitation.)

Anthropology of the pelvis with reference to parturition. William E. Caldwell, M.D. (by invitation), and Howard C. Moloy, M.D. (by invitation), New York City.

Leukemic bone changes with differential diagnosis. E. C. Vogt, M.D., and James Baty, M.D. (by invitation), Boston, Mass.

The relation of extra articular fractures to traumatic arthritis. Howard P. Doub, M.D., and Horace C. Jones, M.D. (by invitation), Detroit, Mich.

Limitations of roentgenography in diagnosis of gout. C. G. Sutherland, M.D. (by invitation), and Philip S. Hench, M.D. (by invitation), Rochester, Minn.

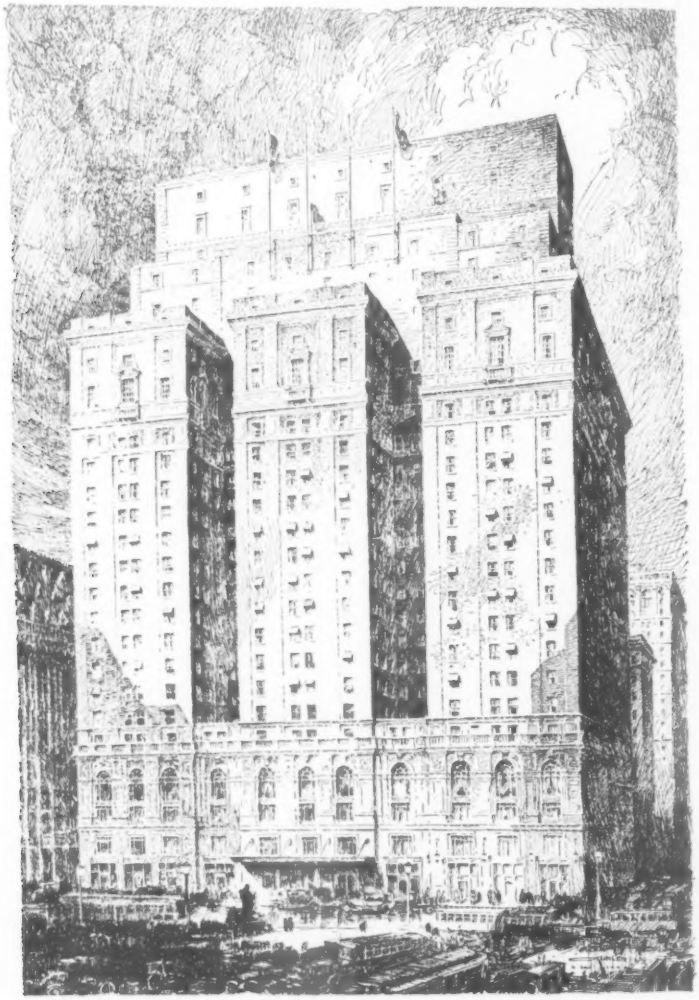
The place of the roentgen-ray museum in the teaching program of the medical school. W. Edward Chamberlain, M.D., and Barton R. Young, M.D. (by invitation), Philadelphia, Pa.

Multiple bone tumors with unusual diagnostic and therapeutic characteristics. E. L. Jenkinson, M.D., and J. M. Foley, M.D. (by invitation), Chicago, Ill.

PITTSBURGH, PAST AND PRESENT

In 1728 the site of the City of Pittsburgh where the Allegheny and Monongahela Rivers join to form the Ohio was a rugged wilderness interspersed by marshes and trails far from the Western Frontier of the British—the Allegheny Mountains. Here was destined to be a battle ground of England and France until the Treaty of Paris in 1763, when France lost, with the exception of the Isle of New Orleans, all claims in America to England. Here at the Block House, one of America's greatest historical spots, it was determined that ours was to be an English-speaking country.

By the year 1748, the strategic position of the "Forks" at the headwaters of the Ohio was immediately recognized and became a point of contention between the English, French and Indians in the great struggle for the Continent.



Hotel William Penn

With the avowed purpose to further Indian trade but actually to establish an English settlement, a group of gentlemen from Maryland, Pennsylvania and Virginia organized the Ohio Land Company in 1748. In 1753, the work on the fortification at the "Point" was begun by the Company, and a militia from Governor Dinwiddie of

Carnegie Institute

Virginia was sent to garrison the outpost. Before its completion, the French under Contrecoeur captured, finished and named it Fort Duquesne in honor of the Governor of Canada at that time.

Despite Governor Dinwiddie's protest against the French occupation, the attempt of Lieutenant Colonel Washington to reenforce the English garrisons in 1754, and that of General Braddock to drive the French out of the Ohio Valley, the French held the Fort from 1754 to 1756, when they fired the stockade and fled before the superior forces of General Forbes. The British Flag was unfurled on November 24, 1758, over the fort, and, in honor of William Pitt, Prime Minister of England and friends of the colonists, the settlement was named Pittsburgh.

Pittsburgh's access to twelve thousand miles of navigable waters early gave it prominence as a commercial center. The traders, some of whom were English, were the first commercial agents before and during the French occupancy of Fort Duquesne. Within a short time after its occupancy by the English in 1758, Pittsburgh, the most important trading post in the western country, nurtured a fair-sized village of some four hundred people outside the garrison.

An appraisal of Pittsburgh in 1787 exhibits a town, not very large, with its men of integrity and dignity—lawyers, clergymen and doctors; its newspapers, places of worship, a post office, a market place, and an educational institution in embryo. The settlement was now a county seat, a manufacturing town, and the "principal depot" on the highway to the western country. In 1790, six Conestoga wagons regularly arrived in Pittsburgh from the East, but long pack horse trains carried the bulk of merchandise.

About this time, iron ore was discovered on the western slope of the Allegheny Mountains, and close upon the discovery of ore followed the inception of the lumbar and glass business, and since that time, through various vicissitudes of fortune, Pittsburgh has grown with the industrial expansion in the United States until it stands today as one of the great manufacturing cities of this country. Nestled as it is among the mountains at the junction of the Allegheny and Monongahela Rivers, its natural beauty and situation offers an opportunity for its great park system of which the city boasts, among these being Schenley Park, Highland Park, West Park, North County Park and South County Park. Some of the other points of interest are the Old Block House at the lower end of Pennsylvania Avenue, the remains of Fort Pitt which was built in 1759, the Point Bridge for a view of the confluence of the Allegheny and Monongahela Rivers, the Liberty Tubes, 6,280 feet long, the broadcasting station KDKA in the Hotel William Penn, the H. J. Heinz Plant, largest establishment of its kind in the world, the Carnegie Institute of Technology, the Cathedral of Learning (University of Pittsburgh) forty-one stories high, and many others. The hospitals include the Allegheny General Hospital, Children's Hospital, Elizabeth Steel Magee Hospital, Homeopathic Medical and Surgical Hospital and Dispensary, Mercy Hospital, St. Francis Hospital, Western Pennsylvania Hospital, and numerous others.

It is possible to list but a small portion of the many points of interest in and about Pittsburgh. Fuller information may be gained upon arrival at the Hotel William Penn or the Pittsburgh Chamber of Commerce.

THE COMMERCIAL EXHIBIT

The Commercial Exhibit at the Annual Meeting of the American Roentgen Ray Society in Pittsburgh promises many interesting features. The room in which the exhibit is to be held is a spacious one next to the scientific sessions. The manufacturers themselves have seemed enthusiastic and the exhibit will be the largest which the Society has ever had. Every person who attends the meeting is urged to

make a careful inspection of all apparatus displayed. The following will give some idea of the scope of the exhibits:

The Du Pont Film Manufacturing Corporation will feature roentgenograms showing unusual pathology. Also there will be on display samples of the other film products of this Company.

Full-length roentgenograms of adults will be one of the outstanding exhibits of the Eastman Kodak Company. These roentgenograms were made on one film with one exposure. Such roentgenograms offer interesting possibilities in studies of multiple fractures and dislocations, malignant metastases and postural defects. The ease with which these roentgenograms are made is outstanding.

Roentgenograms made with Eastman Ultra-Speed Safety Film will be on display as well as a number of interesting and unusual clinical photographs.

The Eastman Mobile Radiographic Stand and other accessories of Kodak manufacture will also be shown.

The new Eastman X-ray Laboratory Manual is to be distributed free to members of the Society and their technicians. This Manual should be of value as a handy reference text in all laboratories.

In the exhibit of the General Electric X-ray Corporation the roentgenologist will find on display a new series of x-ray tables, embodying proved practice and anticipating future trends. These tables feature x-ray and electrical protection, solidity of construction, ease of manipulation, and simplicity of design. They are available with either hand or motor mechanism for raising and lowering the table top.

The new G-E Shock Proof Deep Therapy Tube Stand and improved oil-pressure cooling system for therapy tubes will also be on display. In addition will be shown various models of oil-immersed shock proof x-ray apparatus, XP series x-ray tubes, supplies and accessories.

Visitors to the Keleket Exhibit will have an opportunity of viewing one of the greatest advances made in recent years with relation to shock proofing deep therapy equipment—the new Keleket Shock-Proof Ray-Proof Therapy Tube Stand which ideally meets requirements of the experienced roentgenologist. Many of the visitors to the Keleket booth will immediately observe a number of their own suggestions in the design of the stand since roentgenologists actually contributed to the specifications for the stand. This Stand has great facility of adjustment —360 degree movement in each plane; an absence of cables in proximity to the patient; a success in tube travel and perfect filter system. There will also be on display a complete self-contained x-ray unit which provides facilities for roentgenoscopy, roentgenography and Potter-Bucky diaphragm roentgenography. This complete outfit features the latest in shock-proof design and an innovation is introduced in a Remote Control Stand of the unit and the general operating and constructional features of the table and shock-proof head.

The new Keleket Theron, an x-ray transformer especially adapted to therapy with greater efficiency r-unit production than ordinary valve or mechanically rectified transformers, will also be on display. The Theron is an improved type of Villard circuit, ultra-modern in design, simple in construction, unusually efficient, consistent in its therapeutic results, unaffected by changes in humidity, and occupies a limited floor space to provide for practically any installation difficulty.

The exhibit will contain other new developments as well as a large and striking display of roentgenograms.

The Machlett Laboratories will exhibit a new line of ray-proof and shock-proof roentgenographic x-ray tubes.

The Patterson Screen Company will show their Fluoroscopic and Intensifying Screens. Considerable interest should be created by the Type B Fluoroscopic screen which will be on display.

The Philips Metalix Corporation will show a few of their outstanding develop-

ments of roentgenographic and therapeutic equipment. Philips has always advocated the principle that x-ray equipment cannot be better than the tube that is embodied in it. Therefore, Philips' developments put the x-ray tube in the foreground.

In the focus of interest of roentgenologists for the last two years has been the tube with rotating target, the Philips' Rotalix Tube. It will also be in the center of the Philips' exhibit, both shock-proof and non-shock-proof. It will be demonstrated how fine focus, as heretofore used only for bone detail, can be combined with practically any heavy load. The Metalix HA Tube will second the Rotalix. The HA Tube represents the latest type of Metalix air-cooled but with a capacity equalling and in some respects exceeding water-cooled tubes.

In the therapeutic line, Philips will show their Shock Proof 200 kv. Equipment, which is outstanding for the compactness and elegance of design, the extreme flexibility with which the tube on a floor stand or a ceiling suspension holder can be handled and adjusted. Attention is called to the fact that the Philips' tube on account of its extremely small diameter can be used for contact treatment of surface tumors with *hard* radiation to eliminate depth effect as well as for the treatment of deep-seated tumors where a maximum of depth effect is required.

Standard X-Ray has promised a surprise for the Pittsburgh meeting. It has been reported that they will exhibit an entirely new and improved Shock-Proof Deep Therapy Tilting Tube Stand. This Tube Holder is pivoted upon an axis so that the x-ray tube may be raised or lowered through an arc of 90 degrees and the tube revolved in its holder 300 degrees. It is said that any part of the patient's body can be treated from any angle with the patient in a comfortable position. This new type of X-Ray Tube Holder has attracted wide interest among roentgenologists who will be able to see it demonstrated for the first time at the Pittsburgh meeting. Standard will also show a new high powered roentgenographic special x-ray generator, providing full wave rectification.

The Westinghouse Exhibit will include the following: Complete equipment for a Deep Therapy Department for operation at 25 ma., 200 kv., including Westinghouse Theradex X-Ray Generator; Shock-Proof Radiation-Proof Deep Therapy Tube Stand with Oil Cooling System, and Westinghouse Integrating X-Ray Dosage Meter.

Westinghouse Mobile Shock-Proof X-Ray Unit; two new Westinghouse X-Ray Tables, including new Shock-Proof Roentgenographic Tube Stand; a group of striking roentgenograms and several new x-ray accessories.

REDUCED RAILROAD FARES TO THE MEETING

The railroads have allowed the members of the American Roentgen Ray Society and their families attending the meeting in Pittsburgh a reduced fare of fare and one third of the current one way first class fares on the certificate plan, provided 100 or more certificates are presented. The certificates are on sale September 19 to 25, 1934, and the final honoring date is October 2. Members attending the meeting are urged to secure these certificates when purchasing their tickets.

THE INDISCRIMINATE USE AND RENTAL OF RADIUM

The following resolution was adopted by the American Radium Society at its Annual Meeting in Cleveland, June 11–12, 1934, and by the Board of Chancellors of the American College of Radiology at its Conference in Cleveland on June 13, 1934.

Whereas it is now recognized that radium has been demonstrated to be of definite value in the treatment of disease, and

Whereas some States and many communities in the country have little or no radium available, and

Whereas funds are not always available for the purchase of suitable preparations of radium for use by these physicians who are qualified in radium therapy, and

Whereas we recognize that radium is an agent quite as potent for doing harm as for doing good when used without sufficient skill or training and with the hope of protecting the uninformed public from serious and irreparable injury from improper and insufficient treatment.

Be It Resolved that we consider it improper, unethical and detrimental to the science of radiology and to the good of suffering humanity for commercial laboratories to attempt to give advice or directions as to the use of radium in the case of a patient whom the person giving that advice has not even had the opportunity to examine. In other words, it is just as difficult to give such advice and directions as it would be for a surgeon to give directions for the use of rented surgical instruments so that an untrained physician might attempt an operation. Various commercial companies advertise both in the journals and through the mails, medical advice for the purpose of making sales or renting radium or radon. This places these corporations in the field of practicing medicine.

Be It Resolved that the same criticism be applied to institutions which rent or furnish their radium to those members of their Staff or outside of the Staff who are unskilled in radium application.

Resolved that the same criticism applies to many individual owners of radium.

Resolved that we regard the approval of the American Board of Radiology as the minimum standard for those assuming the responsibility for using radium. We recommend as wide publicity of this Board's existence and approval as is possible to the public, consistent with ethical practices, as the most effective safeguard which can be afforded them.

Resolved that we recommend the refusal of advertising matter in national and state journals when the companies concerned are advertising a Medical Consulting Service or are advertising such service through the mails in connection with their sale or rental of radium.

Resolved that we disapprove of any doctor's acting as a Consultant to a commercial company carrying on such a campaign of public or private advertising and that we consider such an association sufficient grounds to warrant disbarment from the approval of the American Board of Radiology.

Resolved that we recognize the ethical commerical company as a necessity. It is the advertised Consulting Service that is at fault. It is recognized that such restrictions on the advertising of a Medical Service will in no way hamper properly qualified radium therapists in obtaining adequate supplies of radium or radon for the purpose in which they are qualified to employ it.

Resolved that we approve an informal Medical Consultant for the guidance of those commercial companies who refrain from advertising such professional service, either publicly or privately and that in such case their informal Consultant be one approved by the American Board of Radiology.

THE AMERICAN BOARD OF RADIOLOGY

The first examination given by The American Board of Radiology was held in Cleveland at the Hotel Cleveland June 10, 11 and 12. At this session 172 applicants were examined. A majority of these applicants were pioneers in radiology and many of them made the trip for the sole purpose of appearing before the Board in order to secure certificates. This reponse was most gratifying as it gave evidence of support by those men who have contributed so much to the specialty. A list of those who were granted certificates will be published shortly.

There are still approximately 150 applications from men who have not yet presented themselves for examination. Further examinations will be conducted in Pittsburgh, September 22, 23 and 24, and in Memphis, December 1, 2 and 3. It is urged that those who wish to come before the Board at Pittsburgh have their applications on file prior to August 1, and that those who desire examination at the session in Memphis forward their applications not later than September 1.

B. R. Kirklin

Secretary, American Board of Radiology

NEW OFFICERS

The following officers were elected at the Nineteenth Annual Meeting of the American Radium Society held in Cleveland, June 11 and 12, 1934: President, William H. Cameron, New York City; President-Elect, George W. Grier, Pittsburgh; First Vice-President, Maurice Lenz, New York City; Second Vice-President, Lawrence A. Pomeroy, Cleveland; Secretary, Edward H. Skinner, Kansas City (re-elected); Treasurer, Zoe A. Johnston, Pittsburgh (re-elected).

DEPARTMENT OF TECHNIQUE

Department Editor: Robert B. Taft, M.D., Ph. D., 105 Rutledge Ave., Charleston, S. C.

SPECIAL DEVICE FOR URETERAL COMPRESSION IN INTRAVENOUS UROGAPHY

By W. H. STEWART, M.D., H. E. ILLICK, M.D., *and* H. R. KENYON, M.D.
NEW YORK CITY

WHEN Dr. Swick visited Lenox Hill Hospital and kindly demonstrated intravenous urography on a few cases, he emphasized the use of the rubber compression bladder as an essential of the roentgen technique. This serves several purposes, the bladder compressing the area under examination so that it is thinner and detail is therefore superior because there is less tissue to penetrate. There is also less movement of the organs if the patient is unable to suspend respiration completely. Compression probably exerts some direct ureteral pressure which aids in obtaining better detail of the renal pelves and ureters. The uniform abdominal pressure obtained by using a rubber bladder displaces the gastrointestinal viscera to the sides of the abdomen so that gas-filled intestinal loops are less likely to obscure the renal areas.

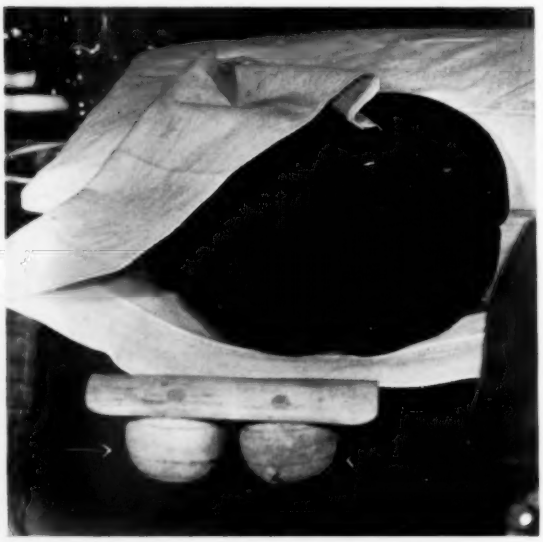


Fig. 1. Special compression device.

Intravenous urography is most successful in outlining the renal pelves and ureters when a partial obstruction with resulting dilatation of the pelves and ureters is present, especially when the renal function is not greatly impaired.

In normal cases the resulting shadows of the renal pelves and ureters are faint and often the examination fails to reveal satisfactory, clear-cut outlines. This is especially true in individuals weighing 180 to 225 pounds in whom, in our opinion, no amount of general abdominal compression will produce sufficient pressure on the ureters to make any perceptible delay in the passage of urine.

The idea of ureteral compression is not new but has been advanced on several occasions as a means of blocking the opaque material in the kidneys and ureters and thus obtaining denser shadows and clearer detail. Overlying the sacroiliac articulations are two hollows in the posterior bony pelvic wall, each concavity containing a ureter passing downward into the pelvis. The posterior bony pelvis forms a kind of ridge at this point and compression over this area by a rounded mass might be expected to cause a certain degree of blockage of the ureters. With this idea in mind two rubber balls were obtained such as children use in playing. A basswood splint was broken into two pieces and the balls strapped to the wood with adhesive tape. Such a compression device would fit into the sacral concavity like a ball in a socket or a clenched fist in the cupped hand.

The results with this compression were much superior to those obtained when the large rubber bag was used alone. This compressor placed just above the symphysis and beneath the regular large rubber bladder, the whole being held down under tension by the Bucky strap, makes a vast improvement in the quality of the resulting roentgenograms. Normal cases now give renal shadows many times the equal of retrograde pyelography and the ureters are plainly outlined in the upper two-thirds.

The cheap rubber balls, however, cast undesirable shadows which can be overcome by the use of similar balls made of balsa wood which are radiolucent, enabling study of the ureters to be made without confusing overlying shadows (Fig. 1).

Fig. 2. Kidney pelves, calyces and ureters under special compression. Note the detail of upper ureters.

Fig. 3. Kidney pelves, calyces and ureters immediately after release of compression. Note the detail of lower ureters.

The method results in such marked improvement that it is highly recommended as a routine procedure for this type of examination. The discomfort to the patient is slight and the results obtained are very satisfactory (Fig. 2).

After having obtained satisfactory detail of the renal pelves and upper ureters, the special compression is removed and another film immediately taken which usually shows the lower ureters and the bladder (Fig. 3).

INDEX TO ABSTRACTS

ROENTGEN DIAGNOSIS

Head

Adelstein, L. J., and Courville, C. B.: Traumatic osteomyelitis of the cranial vault.. 258

Gardner, W. J., and Nichols, B. H.: Encephalography in surgical lesions of the brain. 258

Neck and Chest

Pancoast, H. K.: Roentgenology of the pharynx and upper esophagus..... 258

Engelstad, R. B.: A case of ossification of the stylohyoid apparatus..... 259

Paggi, G.: Fistula between the esophagus and lung and diverticulum with an atypical course in a case of mega-esophagus..... 260

Trepiccioni, E.: The roentgen picture of the azygos vein in the normal position..... 260

Lopo de Carvalho, Egas Moniz and Aleu Saldanha: The visibility of the pulmonary vessels (angiopneumography)..... 260

Lopo de Carvalho, Egas Moniz and Almeida Lima: Angiopneumography and its application in pulmonary tuberculosis..... 261

Bloch, R. G.: Localized experimental tuberculosis of the lungs..... 262

Stewart, C. A.: The evolution of tuberculosis in the human lung..... 262

Dall'Acqua, V., and Valsecchi, R.: Interlobar pleurisies..... 262

Feci, L.: Pneumoconiosis in workers in barytes 263

Flinn, J. W., Flinn, R. S., and Flinn, Z. M.: The correlation of blood counts in 150 clinical cases of tuberculosis and underlying pathological changes as shown by serial x-ray films..... 263

Stivelman, B. R.: Calcified pulmonary miliary tuberculosis..... 263

Opie, E. L., and McPhedran, F. M.: Exogenous tuberculous infection of adults..... 264

Everett, F. R.: The pathological anatomy of pulmonary tuberculosis in the American Negro and in the white race..... 264

Merklen, Pr., Wolf, M., and Sichel, D.: Regressive evolution and healing of giant gummas of the lung followed under the roentgenoscope..... 265

Faulkner, W. B., Jr., and Faulkner, E. C.: Internal drainage; a factor in the production of postoperative massive collapse of the lung..... 265

Tillier, R.: Roentgen diagnosis of suppurated hydatid cysts of the lung..... 266

Smith, D. T., and McBride, A.: Pulmonary abscess in children..... 266

Rogers, W. L.: Primary cancer of the lung.. 266

Banyai, A. L., and Grill, J.: So-called pleuropulmonary endothelioma..... 267

Jalet, J.: Contribution to the roentgen study of pulmonary hila; the Ottonello image.. 267

Lüdin, M.: Aneurysm of the pulmonary artery 267

Bollini, V.: Roentgen determination of the size of the heart in 300 males in their twenties..... 268

Ghimus, and Popesco, A.: A case of spontaneous pneumopericardium..... 268

Smith, H. L., and Willius, F. A.: Pericarditis. I. Chronic adherent pericarditis..... 268

Smith, H. L., and Willius, F. A.: Pericarditis. II. Calcification of pericardium..... 268

Smith, H. L., and Willius, F. A.: Pericarditis. III. Pericarditis with effusion..... 269

Menard, O. J., and Hurxthal, L. M.: Changes observed in the heart shadow in toxic goiter before and after treatment..... 269

Hansen, O. S., and Maly, H. W.: The effects of thoracoplasty on the heart..... 269

Fatou, E., and Heim de Balsac, R.: Roentgen semeiology of left diaphragmatic eventration with report of personal cases..... 270

Abdomen

Rowe, A. H.: Roentgen studies of patients with gastro-intestinal food allergy..... 270

Popp, L.: Esophageal diverticula in connection with several illustrative cases..... 270

Israelski, M., and Simchowitz: On the roentgen diagnosis of the relief of the esophageal mucosa..... 271

Shapiro, P. F., and Kasabach, H. H.: Duodenal ileus; effect of chronic duodenal obstruction on evacuation of the gallbladder 271

ROENTGEN AND RADIUM THERAPY

Blass, G., and Goldhammer, H.: Roentgen treatment of climacteric symptoms..... 272

Saltzstein, H. C., and Topcik, A. A.: The treatment of carcinoma of the cervix in Detroit, Michigan..... 272

Simon, S.: Value of irradiation in papillary ovarian tumors..... 272

Püschel, A.: The roentgen treatment of my-

omas and hemorrhagic metropathies over a single abdominal field ... 273
Pfahler, G. E.: Irradiation in the treatment of bone tumors ... 273
Cutler, Max: The treatment of carcinoma of the cervix with small quantities of radium ... 274
Unseld, E.: Successful roentgen treatment of a case of stubborn diphtheria of the vagina ... 274
Barringer, B. S.: The technique of the suprapubic implantation of radon seeds in bladder carcinoma ... 274
Markow, D. A., Gorjelik, R., and Liwschitz, S.: Roentgen treatment of spinal gliosis ... 275

MISCELLANEOUS

Epifanio, G., and Cola, G.: Experimental study of irradiation of the hypophysis ... 275
Wulff, H.: The rapidity of sedimentation of erythrocytes in malignant tumors before and after roentgen and radium treatment 276
Reinhard, M. C.: An analysis of the factors entering into radium pack intensities ... 276
Bonanno, A. M., and Verano, G.: Irradiation of the dorsal chain of sympathetic ganglia and its effect on the stomach ... 277
Polzien, F.: Theories in regard to the elective action of roentgen rays on cells ... 277
Zwerg, H. G.: The general action of roentgen rays with special reference to the time of its occurrence ... 277
Herzfeld, E., and Anton, G.: Tyndallmetric serum examinations in protracted fractional roentgen and radium irradiation ... 278
Flint, H. T., and Grimmett, L. G.: A critical note regarding units of measurement of roentgen rays and gamma radiation ... 278
Sievert, R. M.: Note regarding units of measurement of roentgen- and gamma-radiation ... 279
Herrnheiser, G.: Preliminary experiences with protracted fractional irradiation ... 279
Löw-Beer, A.: Experimental study of the biological action of roentgen rays ... 280
Caló, A.: Effect on the reticulo-endothelial system of irradiation of tumor animals ... 281
Uhlmann, E.: Experimental study of the effect of diet on the sensitiveness of animal tissues to irradiation ... 281
Schmitz, W., and Schaefer, H.: Effect of roentgen irradation on the action current of nerves ... 281
Shdanow, D. A.: Roentgenologic investigation of the lymphatic systems of human and animal subjects ... 281
Fried, C.: Sterilization by a single one-field irradiation ... 281
Biro, S.: A case of injury of the fetus by roentgen rays ... 282
Granzow, J.: Effect on the fetus of extragenital radium irradiation during pregnancy ... 282
Drips, Della G., and Ford, Frances A.: The study of the effects of roentgen rays on the estrual cycle and the ovaries of the white rat ... 283
Fuhs, H., and Politzer, G.: The effect of roentgen rays on cell division ... 283
Adler, K., and Adler, Margarethe: The effect of roentgen irradiation on calcium and potassium metabolism in rabbits ... 283
Hartoch, W., and Israelski, M.: Effect of roentgen rays on the function of secreting organs ... 284
Maruyama, K.: Some experimental studies of "roentgen sickness" and "roentgen death" ... 284
Franke, H.: The application of roentgen paper to roentgenologic exposures ... 284
Juris, K.: The application of negative paper to roentgenographic technique ... 285
den Hoed, D., and Woldringh, B. M.: Disturbances affecting the radiation output of roentgen tubes ... 285
Kögel, G.: On the problem of the sensitivity of organic desmotropic compounds to roentgen rays ... 285
Kögel, G.: On the question of desmotropism of some organic compounds and their sensitiveness to roentgen rays ... 286
Kudisch, B. M.: The functional-dynamic method of cardio-roentgenology ... 286
Chaoul, H.: A procedure to produce by one exposure two negatives of different quality ... 286
Widemann, M.: The relative output of roentgen tubes in the Greinacher and Witka circuits in an apparatus with an alternative connection ... 286
Ott, Paul: Superimposed striations in roentgenograms ... 286
Schmitz, W.: An experimental study of the voltage curve in roentgen apparatus ... 286
Bouwers, A.: A new method of cooling the anode of a roentgen tube ... 286
Hayer, E.: Observations of the blood picture in roentgen irradiation ... 287
Schreus, H.: The present status of surface therapy ... 288
Stewart-Harrison, R.: Further results in protracted fractional roentgen irradiation with remarks on simple fractional roentgen irradiation ... 288
Pirkel, H. B.: A method of recording roentgen-ray readings ... 290

Bouwers, A.: Research and development in the field of roentgen technique..... 290
Åkerlund, Å.: Some new types of variable tube-shaped primary diaphragms..... 290
Greenberg, S.: Pulmonary roentgenography of small experimental animals..... 290
McKeown, R. M., Harvey, S. C., and Lumsden, R. W.: The breaking strength of healing fractured fibulae of rats..... 290
Wallgren, A.: Study of the biological effects of gamma rays..... 291
Kadrnka, S.: Experimental intravenous osteomyelography..... 291
Whitman, W. G.: Some observations of the effects of radium irradiation on tissue cultures..... 291
Gettler, A. O., and Norris, C.: Poisoning from drinking radium water..... 292
Palmieri, G. G.: The ideas of reversibility and non-reversibility in the radiotherapy of tumors..... 292
Stahel, F., Simon, S., and Johner, W.: Clinical importance of secondary beta rays in radium treatment..... 292
Sievert, R. M.: The new apparatus for teleradium treatment used at Radiumhemmet 292

ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

ROENTGEN DIAGNOSIS

HEAD

Adelstein, L. J., and Courville, C. B. Traumatic osteomyelitis of the cranial vault. *Arch. Surg.*, April, 1933, *26*, 539–569.

Traumatic osteomyelitis of the flat bones of the skull is an uncommon complication of injuries of the head. It is preventable in many cases by suitable treatment of the wounds of the scalp.

The authors suggest a classification of the lesion based on roentgenologic and clinico-pathologic study for none of the patients were subjected to radical surgery or died. Under the heading *localized osteomyelitis* has been included all types which remain purely local and which are a response to an ingress of infectious material resulting in a local inflammatory reaction which heals by a sclerotic process. *Sclerosing osteitis* and *circumscribed osteomyelitis* are subgroups under this heading. In *spreading osteomyelitis of the skull*, the infection begins at a fracture line in the skull, or at the margin of an operative defect. It travels along opened diploic channels and when such spaces are followed until two meet a sequestrum is formed. Extension through the inner and outer tables frees this sequestrum. In *infectious necrosis of fragments in comminuted skull fractures* there is a direct or indirect infection of the fragments from contaminated overlying wounds or a secondarily infected operative wound. The process is limited in the surrounding bone but the fragments already separated from their blood supply soon become sequestrums.

Six cases of various pathogenesis are reported. The characteristic roentgenographic findings are irregular areas of bone destruction with thickening and sclerosis of surrounding bone and dilatation of the diploic venous channels. Mottled, rarefied, and hazy fragments may be seen in association with comminuted fractures.

The disease runs a chronic but generally benign course. Intracranial and metastatic lesions occasionally develop secondarily. The plan of treatment has been essentially conservative, consisting of daily dressings of balsam of Peru. This substance favors the subsidence of infection and the development of granulation tissue. Surgical intervention is limited to the removal of sequestrums which cannot be discharged through draining sinuses.—*J. R. Andrews.*

Gardner, W. James, and Nichols, B. H. Encephalography in surgical lesions of the brain: report of fifty consecutive cases. *Am. J. Cancer*, Feb., 1933, *17*, 342–347.

The authors stress the fact that encephalography should not be limited to non-surgical lesions. They have utilized this procedure in 50 cases; some showed choking of the optic discs, and in several, the intracranial pressure was extremely high.

They stress the necessity of being prepared to do a craniotomy in cases with increased intracranial pressure, just as this procedure has been recommended in ventriculography. The authors describe a technique that is used while introducing air into the subarachnoid space.

In their series of 50 cases, 14 cerebral hemispheric tumors and 5 cerebellar tumors were verified histologically and 5 additional cases were not verified histologically. In the remaininb cases the diagnoses were verified and were as follows: brain abscesses, 6; suprasellar tumors, 4; external hydrocephalus, 4; subdural hematoma, 3; subdural effusions, 2; pituitary adenoma, 1; stricture of aqueduct of Sylvius, 1; and 1 of each of the following: extradural hemorrhage, subcortical hemorrhagic cyst, cerebellar arachnitis, diffuse subarachnoid nevus, and aneurysm of the basilar artery. The findings in each of these lesions are analyzed in the article and the authors show roentgenographic illustrations. Dr. Adson, in discussing this paper, believes that the authors have been rather bold in advocating encephalography for patients with increased intracranial pressure, but that he has also been cautious about being prepared for a craniotomy when he is employing encephalography in such cases.—*E. P. Pendergrass.*

NECK AND CHEST

Pancoast, Henry K. Roentgenology of the pharynx and upper esophagus. *Am. J. Cancer*, Feb., 1933, *17*, 373–395.

The various conditions for which the pharynx and the upper esophagus may be examined include foreign bodies, neoplasms, inflammatory conditions, paralyses, injuries, and anomalies. The subject of foreign bodies is not included in this presentation, except in connection with differential diagnosis.

The basis for the diagnostic possibilities in this location are the following factors: (1) The soft tissues of the neck surround a more or less open, air-containing space above the esophagus, comprising the oropharynx, pharynx, pyriform sinuses, and larynx. (2) The structures which bound this space cast definite shadows and can therefore be differentiated by contrast. (3) The air space can be encroached upon or displaced visibly by inflammatory swellings or neoplasms. (4) The structures bounding the space can be appreciably and characteristically altered in appearance or displaced by the same processes. (5) A certain normal range of movability of many of the structures can be determined, and fixation or restriction in movement can then be detected by fluoroscopic observations. These structures include the soft palate and uvula, the tongue, the larynx as a whole, and the arytenoid cartilages separately. (5) The collapsed potential space of the upper esophagus can be filled with an opaque medium to outline its lumen and its location. (7) The dense cervical spine, with its fixed relations, serves as a means of estimation of displacements and the comparative measurements of spaces, their locations, and the thickness of their walls.

Under technique, the author stresses the value of the fluoroscopic examination with and without the aid of the opaque mixture, and during phonation and the swallowing act. The reason for this is to determine the following points: (1) The movability of the soft palate, tongue, epiglottis, arytenoids and the entire larynx. (2) The outlines of possible growths involving the soft palate, epiglottis, base of the tongue, pharynx, pyriform sinuses, and upper esophagus. Growths of the dorsum or root of the tongue interfere with the forward projection of that organ. Those of the soft palate prevent elevation of that structure on the attempt to whistle. Lesions of the pharynx and pyriform sinuses interfere with the swallowing act in various ways. (3) The integrity of the motor mechanism of the oropharynx, pharynx, and upper esophagus. (4) The patulousness of the food passages. (5) The position of the food passages.

Roentgenograms are made after a thorough fluoroscopic study.

The swallowing act is discussed and is divided into several stages which are as follows: (1) Filling of the mouth and movement of the base of the tongue backward toward the postpharyngeal wall. (2) As the bolus begins to move backward from the mouth, the base of the tongue comes against the postpharyngeal wall and tilts the epiglottis very slightly backward. Coincidentally the larynx rises and the arytenoid cartilages come in contact with the under surface of the epiglottis, so that the tongue, epiglottis, and arytenoids form a single homogeneous shadow. The meeting of the arytenoids and epiglottis closes off the air passage into the larynx. (3) As seen by the fluoroscope, the bolus then enters the pharynx and immediately passes down the esophagus. This movement is so rapid, however, that the exact action of the structures concerned could not be determined, though the author felt sure that there was a sudden squeeze of the pharynx to force the bolus into the esophagus while the air passage and the oropharynx were shut off. (4) Return of all structures to the rest position as the bolus disappears down the esophagus.

This is thoroughly analyzed from the physiological and roentgenographic aspects and its differences described by Barclay are discussed.

Under the heading of pathological conditions, tumors of the pharynx, larynx and cervical esophagus are discussed and typical roentgenographic illustrations are shown. The author also discusses inflammatory conditions including retropharyngeal, retro-esophageal or retrotracheal abscess in both children and adults.

Injuries, diverticula, anomalies and atresia of the esophagus are discussed and illustrations shown.

The author's plea is that roentgenologists should recognize that the upper resipratory and upper alimentary tracts are very prolific fields for investigation, and that a great deal of information can be given to the referring physician.—*E. P. Pendergrass.*

Engelstad, Rolf Bull. A case of ossification of the stylohyoid apparatus. *Acta radiol.*, 1933, *14*, 161–174.

A case is described in a doctor thirty-six years of age who came for examination because of a sensation of discomfort beneath and inside the left articulation of the jaw. He had some

difficulty in swallowing and particularly in gargling but no definite pain. He also had a tendency to keep his head slightly inclined to the right. Roentgen examination showed two ribbon-shaped shadows, one on each side, between the lower surface of the temporal bone and the hyoid bone. They were about 3 mm. broad and each was divided into three segments The upper segment corresponded to the styloid process, the lower one to the lesser cornu of the hyoid bone. The middle segments corresponded to the stylohyoid ligaments. The patient also showed an osteoma about the size of a walnut originating from the lower surface of the occipital bone.—*Audrey G. Morgan.*

Paggi, Gastone. Fistola esofago-pulmonare e diverticolo, a decorso atipico, in megaesofago. (Fistula between the esophagus and lung and diverticulum with an atypical course in a case of mega-esophagus.) *Radiol. med.*, Aug., 1933, *20*, 1083–1095.

A case of protracted illness in a man, aged forty-three, is described, in which the intermittent fever at first suggested malaria. Later the lung symptoms were such that a diagnosis of pulmonary tuberculosis was made. Roentgen examination showed disseminated and confluent foci of bronchopneumonia at the base of the right lung with inflammation of the hilus and of the mediastinum and an enormous esophagus with a diverticulum from which a fistula passed into the lung. A second roentgen examination showed that the lung condition was worse but that the fistula was obliterated.

The author explains the long course of the disease and its atypical course on the assumption that the foci of bronchopneumonia and the pleural and mediastinal inflammation when they became acute brought about obliteration of the fistula but on remission of the bronchopneumonia it opened up again and so caused a renewed attack of inflammation and so on alternately until finally the gangrene supervened which caused the patient's death.—*Audrey G. Morgan.*

Trepiccioni, Emanuele. A proposito della immagine radiologica della vena azygos in posizione normale. (The roentgen picture of the azygos vein in the normal position.) *Radiol. med.*, May, 1933, *20*, 609–619.

The author reviews the roentgen picture of the azygos vein first described by Ottonello. For a part of its course at about the level of the 4th thoracic vertebra it runs horizontally from behind forward and in the ordinary roentgen projection gives a pear-shaped shadow. A knowledge of this shadow is of considerable value in pulmonary diagnosis. It changes in form and size during respiration, increasing in size and density during inspiration and decreasin size or even disappearing on forced or blocked respiration. Modifications in the shadow of the azygos vein also give valuable indications in regard to the condition of the circulation in the descending vena cava and the right heart. If there is any obstacle to the function of the right heart or the discharge of the blood from the vena cava, the shadow of the azygos vein becomes denser from stagnation of the blood in the vein. In some cases of ascites with signs of portal hypertension it is not easy to determine whether there is deficiency of the right heart; observation of the vena azygos shadow may help to settle this question. It is often difficult also to make a roentgen differentiation between some forms of adhesive pericarditis and thickening of the mediastinal pleura. In adhesive pericarditis the azygos vein is not involved; if there is any difficulty in the emptying of the vena cava its pear-shaped shadow will be larger and more dense. But in thickening of the mediastinal pleura on the right side, particularly if the zone is involved which covers the lower part of the trachea and the arch of the azygos, there is traction on the vein with deformity and constriction of its lumen making the roentgenogram of it irregular, deformed and indistinct.—*Audrey G. Morgan.*

Lopo de Carvalho, Egas Moniz and Aleu Saldanha. La visibilité des vaisseaux pulmonaires (angiopneumographie). (The visibility of the pulmonary vessels (angiopneumography).) *J. de. radiol. et d'électrol.*, Oct., 1932, *16*, 469–480.

Following the recent work on the roentgen visibility of the cerebral, and still later of the pulmonary vessels, the authors decided to experiment with a similar method for the visualization of the arterial tree of the lungs, thus completing the roentgen study of the circulatory system. After several preliminary research studies on animals which were published in the *Presse médicale*, the authors finally applied the method in the human. They now use the following technique: A special sound constructed for

angiopneumography which is opaque to the roentgen rays is introduced through the median basilic vein into the right auricle. The procedure is carried out under roentgenoscopic control so as to observe the passage of the sound throughout the path of the vein of the arm and subclavian vein into the vena cava. The sound is introduced by means of a trocar or, still better, through a small incision of the vein. It is first plunged into a solution of 10 per cent sodium nitrate. Through a syringe, which is attached to the end of the sound, physiologic saline solution is injected slowly during the entire passage of the sound. It occasionally happens that when entering the external portion of the subclavian vein the sound passes into the external jugular vein. In such a case the elevation of the arm and a slight external pressure on the axillary region will direct the sound in the right direction. When the sound has reached the right auricle the syringe containing the opaque solution is attached and 8 to 10 c.c. of a 120 per cent sodium iodide is injected. During the injection of the last 1 to 2 c.c. of the opaque solution the roentgenogram is made. After terminating the roentgenographic examination the syringe containing the physiologic saline solution is re-attached and some of this injected so as to force the remaining sodium iodide solution out before the sound is withdrawn. The injection is made on an empty stomach with the patient in a sitting position. As a rule, there is very little discomfort connected with the examination and patients are able to leave after the examination is completed. Occasionally they develop a slight cough and complain of a slight metallic taste in the mouth but this disappears within five to ten minutes. Signs of iodism were observed only exceptionally. The roentgenograms are taken during deep inspiration, when the pulmonary parenchyma appears more transparent thus augmenting the contrast detail.

Six cases in which the method was used are briefly reported and the roentgenograms reproduced. The opinion is expressed that the procedure is of value in permitting a more precise study of the hilar shadows. A distinction between hilar adenitis and periadenitis is possible, by clearly demonstrating the juxtaposition of the vascular elements. The so-called Sturtz striations which according to Assmann must be attributed to the blood vessels also receive confirmation. One may separate these striations from the trunks of lymphangitis which lead from the parenchymal lesions to the hilar glands.

The method will probably prove of diagnostic value in certain other pulmonary affections, such as very vascular tumors, cysts which are entirely devoid of blood supply, etc.—*T. Leucutia.*

Lopo de Carvalho, Egas Moniz and Almeida Lima. L'angiopneumonographie et son application dans la tuberculose pulmonaire. (Angiopneumography and its application in pulmonary tuberculosis.) *Presse méd.*, July 13, 1932, *40*, 1098–1100.

The authors previously described their method for the injection of the pulmonary vascular tree by means of a specially constructed sound which is introduced under roentgenoscopic control through the cubital vein directly into the right auricle. The opaque solution consists of 120 per cent pure and freshly prepared sodium iodide, the amount injected being 6 to 8 c.c. Physiologic saline is used for the expulsion of the solution as well as for the washing of the sound during the course of the injection. In this article the method is re-described in lengthy detail and its value is discussed. Several causes of failure are emphasized such as the inability to pass the sound through the vein at the internal extremity of the clavicle (spasm, anomaly of the vein), a too prolonged time between the taking of the roentgenogram and the injection, most of the solution having been already dissipated by the blood stream, and finally, the fact that some apparatus are not sufficiently powerful to permit instantaneous roentgenography. Of these only the first is serious, as the others can be overcome by improved technique. The patients subjected to examination develop very little reaction. In the beginning there is a slight attack of cough and occasionally a slight headache but both soon disappear. Signs of iodism consisting of increased tear secretion and coryza which appeared two to three hours after the injection and lasted for twenty-four hours were observed in only 3 per cent of the cases. The action of iodide on the tuberculous lesions of the lungs when the solution is introduced by the auricular route appeared nil. Not the slightest sign of aggravation, either local or general, was observed in 12 cases of tuberculosis of the lung in which the method was applied. In fact, all these patients

gained in weight, and the temperature, which on the day of injection sometimes slightly increased, assumed its normal curve the day following the examination. In a few subfebrile cases a normalization of the temperature was observed following the test.

The authors wish to emphasize, however, that it is too soon to draw final conclusions. All that can be said at the present time is that the roentgenograms of the chest show new data which are of a decided scientific interest in the roentgen interpretation of pulmonary lesions. The roentgenograms of 3 cases of tuberculosis of the lung are included to prove this contention.—*T. Leucutia.*

Bloch, Robert G. Localized experimental tuberculosis of the lungs. *Am. Rev. Tuberc.*, Feb., 1933, *27*, 143–149.

Localized pulmonary tuberculosis may be experimentally produced by the introduction of an iodized-oil suspension of the bacilli. For prolonged experimentation with pulmonary tuberculosis the oil-carried infection furnishes very good possibilities, and offers the additional advantages of exact localization of the infection immediately following the introduction of the bacilli.—*W. R. Brooksher.*

Stewart, Chester A. The evolution of tuberculosis in the human lung. *Am. J. M. Sc.*, March, 1933, *185*, 346–356.

Primary tuberculous infections of the lungs (childhood type) are revealed on the roentgenograms as parenchymal infiltrations, calcified glands and Ghon tubercles (permanent scars, the end stage of parenchymal infiltrations) and represent different stages in development.

Data bearing on this subject of primary tuberculosis are presented. The report is based on observations on 1,687 children examined at Lymanhurst School for Tuberculous Children in Minneapolis, each being followed over a period of a few weeks to seventeen years. Of the 1,108 Mantoux-negative cases, 4.6 per cent showed lesions which were indistinguishable from those of late stages of primary tuberculosis. Each individual of this group showed no reaction to a second Mantoux test, using 1 mg. of old tuberculin. In 5.3 per cent of this Mantoux-negative group pleural thickenings, bronchiectasis and pneumonia were found. In the 597 Mantoux-positive group, the incidence of intrathoracic lesions demonstrable on roentgenograms was 55.6 per cent, of which 46 per cent showed lesions typical of childhood tuberculosis.

It was found in 73 cases of early and rather extensive parenchymal lesions that the general tendency was first for the lesions to resolve and later to calcify, whereas lesions of the adult type of tuberculosis seldom calcified but tended to spread, cavitate and cause death, especially during the teens. No death occurred in the group of primary parenchymal infiltrations, although a few years ago one would have expected all these patients to have died soon of tuberculosis. None of the calcified parenchymal scars or calcified hilar glands became reactivated later in the production of an adult type of tuberculosis.

The author concludes that the relationship existing between the childhood and the adult type of tuberculosis seems to consist largely in the tendency for the primary infection to prepare the patient for the development of an adult type of tuberculosis should he perchance later experience a reinfection of sufficient severity to produce an intrapulmonary lesion.—*Leslie Osmond.*

Dall'Acqua, Virgilio, and Valsecchi, Romeo. Le pleuriti interlobari. (Interlobar pleurisies.) *Radiol. med.*, Aug., 1933, *20*, 973–1009.

In the diagnosis of diseases of the lungs and pleura the pathology of the interlobar fissures is of more importance than would appear from the literature. Interlobar accumulations of fluid are important because of the variety of pictures which they produce and the difficulty of interpreting them except by roentgen examination and then only by the use of careful technique.

In order to understand anything of interlobar pathology it is necessary to have a thorough knowledge of the anatomy of the pleura and lungs and particularly of the planes which constitute the fissures. Anatomical illustrations and diagrammatic sketches showing the position of the interlobar fissures are given.

While interlobar accumulations of fluid are quite rare as compared with generalized pleurisies, they are certainly not so rare as is generally believed. Pleurisy of the whole of the large incisure is rare and the cases reported in the literature are mostly of the left incisure. On the right, on account of the course of the great in-

cisure, accumulations are limited to one of the two folds, generally the lower one. It is impossible to recognize an accumulation, except perhaps in median interlobar pleurisy, by means of a simple sagittal roentgenogram; diagnosis is possible only by examination in oblique and latero-lateral projections. According to American authors stereoroentgenograms do not give as characteristic images as oblique and lateral roentgenograms. In an anteroposterior projection an accumulation of the upper fold may simulate a parahilar infiltration or an infiltration of the upper lobe or of an accessory posterior lobe. One of the inferior folds may simulate a basal pleural effusion or a sacculated posterior effusion or changes in the parenchyma of the lower lobe of the lung.

A suspected opacity triangular in form with a distinct boundary line above and an indistinct one below argues in favor of a median lobitis rather than an interlobitis of the lower fold. In lateral projections interlobar effusions appear as fusiform or ribbon-like shadows of uniform opacity in the interlobar plane; they have very distinct outlines. Differential diagnosis between inflammation of the middle lobe and an effusion of the lower fold is difficult and sometimes impossible. In infiltrations of the parenchyma near the incisures it is often difficult to say whether the pleura of the interlobar fissure is involved. If the pneumonia is of the right upper lobe, involvement of the interlobar pleura is indicated by a distinct convex lower boundary of the shadow.—*Audrey G. Morgan.*

Feci, Lorenzo. La pneumoconiosi nei lavoratori di barite. (Pneumoconiosis in workers in barytes.) *Radiol. med.*, May, 1933, *20*, 620–624.

The author defines barytes as natural insoluble barium sulphate. In his province there is a considerable dust in preparing barium salts for use in industry and medicine from this mineral. He has made a preliminary study of the lungs of a small number of workers in the industry and finds that there is a barium pneumoconiosis in a considerable percentage of them which is very similar to pneumoconiosis from other mineral dusts. So far as he can determine thus far, this pneumoconiosis does not have any tendency to cause tuberculosis.

While his article was in press an article on barium pneumoconiosis by Arrigoni came into his hands. Arrigoni says that acute lung diseases, pneumonia and bronchopneumonia, are an almost specific complication of barium pneumoniosis but the author thinks this statement requires further confirmation.—*Audrey G. Morgan.*

Flinn, John W., Flinn, Robert S., and Flinn, Zebud M. The correlation of blood counts in 150 clinical cases of tuberculosis and underlying pathological changes as shown by serial x-ray films. *Am. Rev. Tuberc.*, May, 1933, *27*, 488–507.

A correlated study of 150 consecutive clinical cases of tuberculosis was carried out by blood counts and serial roentgen examinations for the purpose of confirming the conclusions, hypotheses and impressions advanced by the authors in 1929. Data obtained in this study have been compared with the previous study which embraced 1,325 consecutive clinical cases. Serial roentgenograms were employed for demonstration of the various pathological changes as they developed. The leucocytic blood picture becomes of great value when the diagnosis of tuberculosis has been definitely established. According to Medlar, the mononuclear leucocyte represents new tubercle formation, the neutrophile tuberculous abscess formation and the lymphocyte indicates healing of the tuberculous process. The authors are of the opinon that the blood cell count in clinical tuberculosis enables the clinician to determine the severity of the infection and the powers of resistance of the body tissues and later materially assists in ascertaining when pathological activity has completely ceased. Thus, he may give fairly accurate prognosis at any stage of the disease and may determine quite accurately how intensive a treatment should be adopted and how long it should be continued. Illustrative cases and roentgenograms accompany the article.—*W. R. Brooksher.*

Stivelman, Barnet P. Calcified pulmonary miliary tuberculosis. *Am. Rev. Tuberc.*, Oct., 1932, *26*, 437–441.

The rare condition of chronic miliary tuberculosis, while known long before the advent of the roentgen ray, has evidently never been discovered during life without its aid. It is rarely possible to make an early differential diagnosis between the acute and fatal type of the disease and the chronic form, but the mere knowledge of the possibility of the latter and a little pa-

tience will often save great distress to the patient and his family and embarrassment to the physician. The exceedingly rare cases of healed or calcified miliary tuberculosis of the lungs are discovered either by routine chest films or after death from other causes. There is little doubt that these individuals had a clinical lung process at one time, the lesion being healed or actually calcified because of the great tissue resistance, an attenuated organism or both instead of being completely absorbed. The greatest difficulty may be encountered in differentiating calcified miliary tuberculosis from broncholithiasis. The lung stones are of uniform size and great density and may be distributed throughout both lung fields, but they do not often cast round shadows on the film. A history of occupational hazards and expectoration of the stones may be available for assistance. Miliary sarcomatosis and carcinomatosis are usually ruled out by detection of the primary tumor.—*W. R. Brooksher.*

Opie, Eugene L., and McPhedran, F. Maurice. Exogenous tuberculous infection of adults. *Arch. Int. Med.*, Dec., 1932, *50*, 945–951.

The literature on tuberculosis contains data for an immense collection of statistics on marital tuberculosis, and nearly every year new studies with varying results are published. Statistics of this paper are the result of direct observation of married couples, and the studies were conducted with the aid of roentgenographic methods.

The number of married couples studied of whom one or both consorts suffered with tuberculosis was 533; 366 were white and 157 negro. Since clinical histories on these cases were carefully prepared, it was possible to determine in which marital partner the disease first developed and whether the sputum of this person was known to contain tubercle bacilli.

From their statistics the writers found that husbands and wives in marital contact with tuberculosis under varying conditions are infected from five to nine times as often as persons with no known contact with the disease; husbands are infected oftener than wives.

The frequency of infection in wives exposed to husbands with tubercle bacilli in the sputum was 35.5 per cent; of this 35.5 per cent there were 12.4 per cent with manifest tuberculosis and 23.1 per cent with latent apical tuberculosis. Frequency of infection in wives exposed to husbands with no tubercle bacilli in the sputum was 22.9 per cent (4.5 per cent with manifest and 18.4 per cent with latent apical).

Incidence of infection in husbands exposed to wives with open tuberculosis was 45.6 per cent (12.9 per cent with manifest and 32.7 per cent with latent apical tuberculosis); when there were no tubercle bacilli in the sputum it was 35.9 per cent (8.3 per cent with manifest and 27.6 per cent with latent apical).

When the incidence of latent apical tuberculosis in persons exposed to tuberculosis in husband or wife is compared with that in husbands or wives with no known exposure to tuberculosis, the possibility that the difference has occurred by chance is negligible.—*W. C. Hall.*

Everett, Franklin R. The pathological anatomy of pulmonary tuberculosis in the American Negro and in the white race. *Am. Rev. Tuberc.*, May, 1933, *27*, 411–464.

This study is based upon 402 necropsies, of which somewhat less than one-half were negroes. There were 335 deaths of causes other than tuberculosis in which tuberculosis had not been recognized during life. Roentgenograms of the chest of the living were taken when possible and of the chest of the cadaver before the body was opened and of the excised inflated lungs. The lungs were hardened in formalin and carefully dissected, a comparison being made between the lesions revealed by dissection and those visible in the films. The childhood and the adult types of the disease are discussed and a table of contrasting characteristics presented. In this series the childhood type occurred only twice in white adults but in 22 of the 44 negroes who died of tuberculosis. In more than half of these cases the lesion had its origin in the apex of the lung. The adult type of pulmonary tuberculosis, which is prevalent in white adults, occurred in only half of the instances of pulmonary tuberculosis in negroes but pursued in them a more rapid course. Widespread tuberculous pneumonia is more frequent and the formation of fibrous tissue is less conspicuous in the negro than in the white. Latent apical tuberculosis occurs considerably less frequently in the negro. Sixty-five necropsy records of illustrative cases are presented with diagrams indicating the anatomical distribution of the lesions in these cases.—*W. R. Brooksher.*

Merklen, Pr., Wolf, M., and Sichel, D. Évolution régressive et guérison de gommes géantes du poumon suivies sous l'écran. (Regressive evolution and healing of giant gummas of the lung followed under the roentgenoscope.) *Presse méd.*, 1932, *40*, 1493–1494.

The authors describe an unusual case of multiple gummata of the lung in which diagnosis was very difficult. The picture was that of a bronchopneumonia but the persistence of the consolidation in the roentgenograms finally led to a change in the diagnosis. Following antiluetic treatment with mercury and arsenic, an immediate resolution of the process started and within twenty days a restitutio ad integrum was obtained. The case is also interesting because there was no other luetic manifestation, the pulmonary condition appearing isolated. The clinical signs were those of hepatization, dullness and bronchial bleeding. Potassium iodide was administered for a period without result. The first roentgenogram was made one month after the clinical symptoms appeared. In describing gummata of the lung most authors insist on the irregular or sinusoidal contours of the foci. In this case the neoformations were truly geometric and they were localized chiefly in the parenchyma.—*T. Leucutia.*

Faulkner, William B., Jr., and Faulkner, Edward C. Internal drainage; a factor in the production of postoperative massive collapse of the lung (pulmonary atelectasis). Suggestions as to prevention and treatment. *Am. J. M. Sc.*, Sept., 1932, *184*, 370–379.

The authors believe that the cause and clinical picture of atelectasis following and independent of surgical procedures can be explained on a combined mechanical and infectious basis. It is due to the presence of excess intrabronchial secretions and the influence of "internal drainage." By "internal drainage" is meant the spilling of material from place to place within the tracheobronchial tree. This spilling follows definite laws and has been proved repeatedly by physical examination, roentgen examination, iodized oil injection, bronchoscopic inspection, operative findings, and autopsy findings.

The sources of excess intrabronchial secretions in those without previous pulmonary disease are the mouth and nasopharynx during and immediately following operation. This aspiration can occur with all types of anesthesia.

The cough reflex is inefficient in prohibiting entrance of foreign material into the trachea and bronchi and the high incidence of aspiration during general anesthesia is proved convincingly by experimental and clinical studies. Seventy-nine per cent of Myerson's cases had blood in the trachea or bronchi after tonsillectomy.

There is evidence that intrabronchial secretions cause atelectasis. The condition is not uncommon with pulmonary abscesses, the atelectasis occurring in the areas where the pus could most readily spill.

Thick plugs of inspissated pus, films of viscid mucoid material, inflammatory edema, or thin secretions which run deeply into and fill minor bronchial stems can cause the bronchial occlusion.

In postoperative atelectasis, thin material enters minor bronchial openings and produces a patchy or lobular atelectasis, while thicker material is likely to plug a larger bronchus and produce a lobar atelectasis. Postoperative atelectasis has a predilection for certain sites, and these areas are identical with those at which lipiodol, blood, and pus collect when patient is in a given position. In kidney operations, the atelectasis usually occurs on the opposite side from the operation because of drainage into the dependent lung. In operations on the chest, the atelectasis occurs where the collected secretions drain and obstruct bronchi. Frequency of right base involvement is due to the anatomical features which allow secretions to drain into this portion of the lung in the semi-Fowler position. One can readily see why the upper lobes of the lung are so infrequently involved. Migrations and recurrences of atelectasis can be shown to be due to shifting the position of the patient so as to allow the chest accumulations to shift. Infection occasionally plays a part in these recurrences. The occasional spontaneous cures and the success of the Sante maneuver are dependent on the principle of internal drainage which permits secretions to spill away from the occluded bronchus.

In the prevention of postoperative atelectasis, the following suggestions are made: careful attention to mouth hygiene, posture of patient during and after operation, and prevention of aspiration and removal of intrabronchial secretions.

In management of patients with postoperative atelectasis these suggestions are made: postural exercises, carbon dioxide inhalations (hyperventilation), and bronchoscopic treatments.—*W. C. Hill.*

Tillier, R. Le diagnostic radiologique des kystes hydatiques suppurés du poumon. (Roentgen diagnosis of suppurated hydatid cysts of the lung.) *Bull. et mém. Soc. de radiol. méd. de France*, June, 1932, *20*, 361–368.

The author classifies infected hydatid cysts of the lungs as follows: (1) suppurated hydatid cysts without rupture (intrabronchial or intrapleural); (2) ruptured suppurated hydatid cysts (*a*) with bronchial and (*b*) with pleural communication.

(1) Non-ruptured, infected hydatid cysts. Inasmuch as infection of a hydatid cyst can occur only after infecting germs have penetrated through the cuticle of the cyst the author classifies as non-ruptured infected hydatid cysts those in which the cuticle is most probably fissured but in which the ectocystic reaction membrane remains intact. In these cases the roentgen appearance will be that of a simple hydatid cyst (homogeneous opacity with regular contours) or that of a pulmonary abscess with or without the presence of gas according to the nature of aeroby or anaeroby of the infection, a differential diagnosis often appearing impossible. The presence of several cysts within the lungs or in other parts of the body may aid in elucidating the diagnosis. (2) Ruptured suppurating hydatid cysts, (*a*) with communication into a bronchus in which case the signs of localized or circumscribed pyopneumothorax predominate, and (*b*) with pleural communication in which case one may find (A) an encysted interlobar, purulent effusion which may take the aspect of a closed pulmonary abscess or a localized pneumothorax, and (B) putrid pleuritis or extensive pyopneumothorax.

In discussing the diagnosis in all these types the author emphasizes in addition to the already known differential criteria of the hydatid cysts, two points which are concerned with the appearance of the fluid level if such is present: (*a*) the irregularity of the upper fluid level in hydatid cysts due to the fact that the effusion is mixed with parts of the cuticular membrane protruding above the surface of the fluid and (*b*) the very slow displacement of the level of the fluid, which is perhaps the more characteristic of the two, due to the fact that the contents of a hydatid cyst are thicker and less mobile than the usual pleural effusions.—*T. Leucutia.*

Smith, David T., and McBride, Angus. Pulmonary abscess in children. *South. M. J.*, August, 1933, *26*, 686–692.

Etiologically, pulmonary abscesses can be divided into: (1) bacterial abscesses, for which there is no specific treatment other than vaccines; (2) fusospirochetal abscesses, which require arsenical therapy, and (3) the mycotic infections for which iodides are necessary. The history, physical signs, and roentgen findings may be almost identical in almost all cases and it is very difficult at times to differentiate any one of the three types, in the initial stage, from primary tuberculosis. The final diagnosis must depend upon a study of the sputum.—*W. R. Brooksher.*

Rogers, W. L. Primary cancer of the lung; a clinical and pathologic survey of fifty cases. *Arch. Int. Med.*, June, 1932, *49*, 1058–1077.

The author analyses 50 cases of primary lung cancer. The clinical course of these cases may be summarized as follows: About 80 per cent of the cases were in men, 50 per cent being between the ages of fifty and sixty; 39 per cent of the parents died either from a cancer or of lung infection. About 50 per cent of the cases gave a previous history of chest disease, a few histories being suggestive of recurrent attacks of bronchial stenosis. A study of occupation yielded little information. Forty-four per cent gave as their first symptom one that was not connected with the chest; 12 per cent went through the entire course of illness without pulmonary symptoms. Blood-tinged sputum was observed in only 22 per cent, a fact important enough to be remembered. Hoarseness as a result of recurrent nerve palsy was a rather common finding. The left nerve was more apt to be involved than the right. Marked esophageal disturbance did not play a prominent rôle.

Physical examination may reveal one or more of a large group of pathologic signs. Gradual loss of weight, beginning cachexia and progressive anemia help in diagnosing a malignant process. A marked degree of cachexia was more apt to be found in cases of advanced metastatic involvement. In those cases the suprarenals were frequently involved.

The diagnosis of these lesions can be made by use of the roentgenogram in a goodly number of cases, a series of roentgenograms being of more value than a single plate. Iodized oil may also be of value in diagnosis. The sputum likewise may be of diagnostic aid.

The most important pathological observations made on these 50 cases were as follows: There was an equal tendency to tumor forma-

tion in each lung. Forty-six per cent occurred in upper lobes as compared with 28 per cent in middle and lower lobes. Seventy-six per cent were found in right or left main bronchi, or in the first portion of the bronchi of main lobe. The primary growths in the main bronchi metastasize to mediastinal lymph nodes in an early stage and are a little slower to metastasize by the blood stream. A varying degree of bronchial stenosis is always present in bronchial carcinoma, and is often accompanied by peripheral bronchiectasis or in a few cases peripheral abscess. Atelectasis is a frequent finding. Various pneumonic changes are often present. In some cases enlarged, chronically inflamed lymph nodes were found around the hilar region as evidence of a long-standing previous inflammatory condition. Pleural adhesions were commonly present, and almost 80 per cent of cases had adhesions on the primary side, these being the result of an old inflammatory pleurisy, inflammatory changes during the present illness, or tumor infiltration, or metastasis. A pleural exudate was present in 52 per cent, while hemorrhagic exudate was present in only 10 per cent. Tumor infiltration and metastasis to the pleura occurred in 36 per cent on the primary side.

Pulmonary carcinomas are usually rather rapidly infiltrating, tending to metastasize early by lymphatic and blood routes. Mediastinal nodes were involved in 80 per cent of these cases. These tumors show a marked tendency to metastasize to bone, cerebrum, liver, and suprarenals.

In this series of 50 cases, carcinoma was the only type of malignant growth found. Bronchial carcinoma was found in 96 per cent and alveolar carcinoma in 4 per cent. Of the bronchial carcinomas, the small cell type predominated.—*W. C. Hall.*

Banyai, Andrew L., and Grill, John. So-called pleuropulmonary endothelioma. *Am. Rev. Tuberc.*, Feb., 1933, *27*, 193–199.

A detailed case report of pleuropulmonary mesothelioma with comments on differential diagnosis is represented. Roentgen study is one of the most valuable methods for diagnosis of malignant disease of the lung, and this study may be aided by the induction of artificial pneumothorax. Bronchoscopy and thoracoscopy are of great value in experienced hands, but, in many instances, it is necessary to open the chest to establish the diagnosis, just as the abdomen is explored. Such exploratory procedures are attended by minimal danger.—*W. R. Brooksher.*

Jalet, J. Contribution à l'étude radiologique des hiles pulmonaires: l'image d'Ottonello. (Contribution to the roentgen study of pulmonary hila; the Ottonello image.) *Bull. et mém. Soc. de radiol. méd. de France*, July, 1932, *20*, 411–412.

In examining the roentgen films of the lungs especially in infants, one not infrequently observes in the region of D_3 and D_4 in the sinus of the tracheobronchial angle a homogeneous oval capacity which is of the size of an olive pit, slightly fuller at its lower pole and which measures in its longest diameter 6 to 8 mm. in the child and 10 to 12 mm. in the adult. This opacity generally continues upwards and sometimes also downwards with a thin striation. It projects most frequently over the mediastinal shadow, a slight right antero-oblique position being the most favorable for its best demonstration. The author calls it the Ottonello shadow in honor of the man who first recognized its true significance, stating that it represents the azygos vein which is roentgenographed through a certain length of its path. It is true that this shadow was described already in 1918 by Crane who observed it in 88 per cent of tuberculous infants but he attributed it to a pretracheal lymphatic gland, thus giving it a definite pathologic significance. The same opinion was also endorsed by Hulot and Kennon Dunham who considered it as an important sumptom of evolutive tuberculosis whether incipient or latent in nature. It is thus the merit of Ottonello of having recognized the true nature of the shadow and the author now wishes to endorse this point of view.—*T. Leucutia.*

Lüdin, M. Aneurysma der arteria pulmonalis. (Aneurysm of the pulmonary artery.) *Acta radiol.*, 1933, *14*, 259–261.

Aneurysm of the pulmonary artery is very rare. The author was able to find only 3 cases in the literature diagnosed by roentgen examination and confirmed by autopsy. He describes such a case in a woman, aged seventy-one, admitted to the hospital with intense dyspnea and cyanosis. Roentgen examination showed a large arched protrusion of the second arch of the heart silhouette which corresponded to the pulmonary artery. This protrusion showed a pulsation that was synchronous with that of the

left ventricle. There was also great enlargement of the right hilar shadow and increased density of the lung outline in the lower parrts of both lungs. The diagnosis of aneurysm of the pulmonary artery was confirmed on autopsy.—*Audrey G. Morgan.*

Bollini, Vincenzo. La determinazione radiologica delle dimesioni del cuore in 300 maschi ventenni. (Roentgen determination of the size of the heart in 300 males in their twenties.) *Radiol. med.*, 1933, *20*, 1021–1083.

The author discusses the results of his orthodiagraphic measurement of the heart in 300 young men between nineteen and twenty-five years of age. He describes his own method of calculating the volume of the heart from the measurements on the orthocardiogram and those of other authors. He emphasizes the practical value of the orthodiagram and its importance in clinical anthropometry.—*Audrey G. Morgan.*

Ghimus, and Popesco, A. Sur un cas de pneumopéricarde spontané. (A case of spontaneous pneumopericardium.) *J. de radiol. et d'électrol.*, Dec., 1932, *16*, 605–607.

The authors had an opportunity to examine a child five years of age in which the clinical and roentgen diagnosis of right-sided pleural effusion was made. Following aspiration of the effusion a pneumothorax developed and on roentgenoscopic examination an associated pneumopericardium was found. The child complained of no dyspnea or any other symptoms resulting from pressure on the heart. After a few days the pneumopericardium absorbed. It is probable that the air entered the pericardial sac through a small opening of the mediastinal pleura. Although a dozen cases of hydro- or pyopneumocardiums are reported in the literature not one case of a pure pneumopericardium is described. The benign course of the lesion is of interest.—*T. Leucutia.*

Smith, Harry L., and Willius, Fredrick A. Pericarditis. I. Chronic adherent pericarditis. *Arch. Int. Med.*, Aug., 1932, *50*, 171–183.

Smith and Willius, studying the records of necropsies of the Mayo Clinic, found 373 cases of pericarditis among 8,912 autopsies. Males accounted for 70 per cent of the cases; 75 per cent were between the ages of thirty and seventy years; rheumatic fever occurred with a frequency of 22 per cent, intrathoracic infection in 17 per cent, cardiac infarction in 6 per cent, and syphilis and neoplasms each in 3 per cent; and in 41 per cent definite evidence of etiologic disease was not found.

The cases were classified as complete obliteration of the pericardial sac, 37 per cent; partial obliteration, 55 per cent; and parietal adhesions, 8 per cent. The average cardiac weight was 578 gm. Associated disease of the heart occurred in 54 per cent,—coronary sclerosis in 22 per cent, mitral stenosis in 17 per cent, hypertensive heart disease in 8 per cent, aortic insufficiency in 4 per cent, and aortic syphilis in 3 per cent.

Only 40 per cent of the cases presented complaints that made the heart the major issue in the clinical picture. No physical signs occurred in this group with sufficient uniformity to permit of their being considered characteristic of adherent pericarditis. Kussmaul's, Friedreich's, Broadbent's, and Cooper's signs are said to be valuable in diagnosis. There was no characteristic roentgenographic contour because most of the patients examined had associated heart disease. Fixation of the electrical axis and R and T waves of low amplitude are suggestive electrocardiographic findings. The heart was directly concerned with death of 40 per cent of cases.

In conclusion, the authors stress the necessity for the development of a clinical sense of suspicion regarding the existence of adherent pericarditis for such an attitude will decrease the large diagnostic error which prevails.—*J. R. Andrews.*

Smith, Harry L., and Willius, Fredrick A. Pericarditis. II. Calcification of pericardium. *Arch. Int. Med.*, Aug., 1932, *50*, 184–191.

Smith and Willius found 15 cases of calcification of the pericardium in the records of 8,912 autopsies of the Mayo Clinic. Chronic adherent pericarditis was present in all. Rheumatic infection was the single etiologic agent which affected the largest number of patients. Intrathoracic infection, coronary sclerosis and syphilis were present in the remainder. Tuberculosis was not present in any one of the cases. The average weight of the heart was 584 gm. The degree of calcification varied from involvement of a few areas to involvement, in one case, of the entire pericardium. Roentgenograms of the thorax had been made in 5 of the cases before death but in none was calcification of the pericardium recognized.

One case is reported in which the diagnosis was made clinically. Roentgenograms showed progressive and extensive calcification of the pericardium in a man aged forty-five with chronic adhesive pericarditis and congestive heart failure.

It would appear that calcification of the pericardium is a sequel of extensive chronic adherent pericarditis and is an end-result of the same inflammatory process that produces chronic adhesive pericarditis.—*J. R. Andrews.*

Smith, Harry L., and Willius, Fredrick A. Pericarditis. III. Pericarditis with effusion. *Arch. Int. Med.*, Aug., 1932, *50*, 192–202.

Smith and Willius, in studying the records of the necropsies of the Mayo Clinic, found 113 cases in which the amount of pericardial fluid was more than normal or in which the fluid was altered in character. The cases were grouped as follows: acute purulent pericarditis, 68 per cent; fibrinous pericarditis with effusion, 27 per cent; tuberculous pericarditis, 2.5 per cent; and non-inflammatory effusion, 2.5 per cent. Males predominated and the average age was forty-three years. Intrathoracic infectious disease was the basis of the pericarditis in about 70 per cent of all cases and sepsis elsewhere in the body was the next most frequent etiologic agent. Three cases of tuberculous pericarditis with effusion and 3 cases of non-inflammatory effusion were recorded. The average cardiac weight was 427 gm. Other disease of the heart was associated with the pericarditis in only 30 per cent of the cases. Hypertensive heart disease, rheumatic heart disease, coronary sclerosis, and acute bacterial endocarditis were associated in frequency in the order given. The average pericardial content was 170 c.c.; 1,500 c.c. was aspirated from a case of tuberculous pericarditis a few days before death. Fluid in one or both pleural cavities was generally present.

Clinically, only 13 per cent presented predominant signs and symptoms of heart disease and the cases as a whole represented a great variety of diseases. Signs said to be characteristic of pericardial effusion were only infrequently encountered. Less than 150 c.c. of excess fluid cannot be recognized. The most reliable sign of effusion is the size and contour of the heart as determined by roentgenography. However, in only 5 cases was the shadow of the heart suggestive of effusion. Pericardial rubs are frequently present in the early stages. Most of the patients died from sepsis.

From the study it appears to be established that the presence of infectious intrathoracic disease offers a great chance of the pericardium being involved, and when infectious processes of the body, as a whole, are considered, the chance of pericarditis is still greater. The presence of such infections should focus attention on the pericardium and the result may be that effusion will be recognized more commonly.—*J. R. Andrews.*

Menard, O. J., and Hurxthal, L. M. Changes observed in the heart shadow in toxic goiter before and after treatment. *Ann. Int. Med.*, June, 1933, *6*, 1634–1643.

One hundred and fifteen cases were studied before and after subtotal thyroidectomy for hyperthyroidism by teleroentgenograms. The first film was ordinarily made within twenty-four hours after the patient came under observation and the second usually within one year after the operation. Measurements were made in the usual way and were then rechecked when all the films on each subject were available for comparison. Further comparison of films was made by superimposition, but it is realized that a statement that the heart shadow has changed in size is in many cases a statement of opinion and not of fact, and is to be considered with the other factors in the case. Uncomplicated cases of toxic goiter with normal rhythm present very little change in the cardiac shadow following removal of the thyroid toxicity by subtotal thyroidectomy. Cardiac dilatation as shown by roentgenograms takes place most frequently in congestive heart failure with or without auricular fibrillation. Definite reduction in size was observed after relief of congestive heart failure, after cessation of auricular fibrillation, and in a few cases without these complications. Certain changes in the shape of the heart shadow may be found which have been described as characteristic of hyperthyroidism.—*W. R. Brooksher.*

Hansen, Olga S., and Maly, Henry W. The effects of thoracoplasty on the heart. *Am. Rev. Tuberc.*, Feb., 1933, *27*, 200–208.

Fifty-seven cases were studied by means of electrocardiograms and the roentgen ray before and after collapse by thoracoplasty to determine the effect of this procedure on the heart.

The study was controlled by 30 cases of uncomplicated pulmonary tuberculosis. Forty-nine, or 87 per cent, of the cases showed more or less displacement of the heart to one side or the other, but more frequently toward the unaffected side. Postoperative changes as shown by the electrocardiogram occurred in 63 per cent, but these were neither constant nor predictable. In 36 cases, there was roentgen evidence of a change of heart position in the same direction, though not necessarily of the same degree. In 11 cases the electrocardiograms and the roentgen ray disagreed, and in 13 they were indeterminate, indicating the impossibility of predicting the probably electrocardiographic change from the study of the film and, conversely, the estimation of the type of roentgen findings from a review of the electrocardiogram. Other factors, such as bed rest, toxemia, and weight changes, doubtless affect the form of the electrocardiogram, since the control patients were also variable in their complexes. No evidence of disturbance in conduction or myocardial damage was shown on the electrocardiograms. Necropsy showed no abnormality in heart weight nor more evidence of myocardial degeneration than is found in other patients dying of tuberculosis. Some of the changes in the Q-R-S amplitude are probably due to changes in muscle tone from reduction of toxemia and increase of exercise, and would appear regardless of the mechanics of collapse. The electrocardiographic changes are probably of extrinsic origin and not related to the condition of the myocardium.—*W. R. Brooksher.*

Fatou, E., and Heim, de Balsac, R. Séméiologie de l'éventration diaphragmatique gauche à propos de cas personnels. (Roentgen semeiology of left diaphragmatic eventration with report of personal cases.) *J. de radiol. et d'électrol.*, Oct., 1932, *16*, 491–505.

Diaphragmatic eventration is usually discovered during a roentgen examination of the cardiovascular, pulmonary or digestive system, in individuals complaining of palpitation, nervousness, respiratory or digestive disorders. The authors were surprised to see the condition occur quite frequently, though reported as rare. In the very advanced cases the diagnosis is simple, but in the cases which show only a slight elevation of the left diaphragm one must resort to examination of the digestive organs by means of the opaque substances. In case that no surgical intervention is indicated the examination is of value in permitting the study of the subsequent course of the condition and the diagnosis of eventual complications, such as ulcer, tuberculosis, etc. Finally, the roentgen examination occasionally may indicate the congenital etiology or that the lesion is secondary to phrenic paresis.

Four cases are briefly reported, several roentgenograms being reproduced.—*T. Leucutia.*

ABDOMEN

Rowe, Albert H. Roentgen studies of patients with gastro-intestinal food allergy. *J. Am. M. Ass.*, Feb. 11, 1933, *100*, 394–400.

Parients with unexplained gastrointestinal symptoms were studied roentgenologically both when rendered symptom-free by diets from which milk and eggs were eliminated and during periods of disturbance when on unlimited diets. Symptoms and ingestion of milk and eggs were coincidental with pylorospasm, gastric retention and colonic hypermotility, roentgen findings being negative when patients were on diet.

The findings point to allergic reaction to milk and eggs and the author believes this not invalidated by the lack of strong skin reactions to these proteins. Four cases are presented in detail, one of which had had gastrojejunostomy.

The author stresses the importance of using rice or cornmeal gruel instead of malted milk as a suspension medium in patients who may be sensitive to milk.—*E. W. Hall.*

Popp, L. Despre diverticolii esofagieni in legatura cu câteva cazuri concludente. (Esophageal diverticula in connection with several illustrative cases.) *Cluj. med.*, Dec., 1932, *13*, 598–603.

Partial ectasias of the esophageal wall may be divided into three groups: (1) traction diverticula of Rokitansky: (2) functional diverticula of Bársony and (3) pulsion diverticula of Zenker. The traction diverticula, as a rule, develop following a traction on the esophageal wall by adhesive or cicatricial processes of the digestive organs (in tuberculosis and anthracosis, siderosis, etc.). The functional diverticula are the result of the relaxation of part of the esophageal wall not infrequently associated. with spasms in other portions of the esophagus. These diverticula may appear temporarily or permanently, transforming into a so-called idio-

pathic dilatation of the esophagus. Their cause lies in a disturbed function of the vagus. The pulsion diverticula may be divided into two groups: the so-called Zenker diverticula which are nothing more than the herniation of the mucosa of the postero-inferior wall of the hypopharynx extending behind the esophagus, and the pulsion diverticula of the esophagus proper which are quite rare and which occur with predilection above or in the neighborhood of the diaphragm (the so-called epiphrenic pulsion diverticula).

Four cases representing various types are briefly reported and illustrated with roentgenograms.—*T. Leucutia.*

ISRAELSKI, M., and SIMCHOWITZ. Sur le diagnostic radiologique du relief de la muqueuse oesophagienne. (On the roentgen diagnosis of the relief of esophageal mucosa.) *J. de radiol. et d'électrol.*, May, 1932, *16*, 197–205.

The authors use for the study of the relief of the esophageal mucosa a rather thick barium mixture. The passage of a swallow of this mixture is observed roentgenoscopically and, in case of a pathological condition, serial roentgenograms of the area involved are made. The most favorable moment for the taking of roentgenograms is a few seconds after the evacuation of the bulk of the opaque substance.

The method is of decided advantage in numerous conditions such as differentiation of mediastinal and esophageal tumors, the study of the extent of involvement or stenosis produced by an esophageal tumor, differentiation from other diseases such as perforation, ulcer, degenerative crater of the esophagus, a diagnosis of lesions of the cardiac region, the differentiation of epidiaphragmatic esophageal diverticula from hernias of the stomach through the esophageal hiatus and finally the diagnosis of esophageal varices and their differentiation from tumors, esophagitis, air bubbles and alimentary residue.

The article includes reproductions of some very illustrative roentgenograms.—*T. Leucutia.*

SHAPIRO, PHILIP F., and KASABACH, HAIG H. Duodenal ileus; effect of chronic duodenal obstruction on evacuation of the gallbladder. *Arch. Surg.*, June, 1933, *26*, 1084–1097.

The authors, in discussing the subject, point out the relationship that exists clinically between chronic duodenal obstruction and biliary disease. They refer to the observations of Orndoff and of Wheelon, who found involvement of the biliary structures in 75 per cent of the 74 cases of duodenal ileus which they studied.

By turning a 40 cm. portion of the small intestine upon its mesenteric axis and suturing it at both ends, they were able to effect a physiological duodenal obstruction. Ten days after operation the investigators were able to demonstrate definite duodenal obstruction without any delay in the emptying time of the gallbladder. About 50 days postoperative, however, everything had returned to normal. Because of the dog's facility to compensate for these reversals the method had to be abandoned. Chronic duodenal obstruction was finally obtained by passing a flap of the posterior rectus sheath through part of the duodenal mesentery. This formed an anterior sling and proved very effectual.

A combined method for visualizing the gallbladder and emptying of the stomach was used to make observations in duodenal motility and gallbladder activity. Ten days after operation the gastric emptying time was increased by one to three and a half hours, and the duodenum was fully 2 times its preoperative diameter. In all of the dogs in which a duodenal ileus had been produced there was found a decreased efficiency of evacuation of the gallbladder of from one to ten hours in the first ten days. Observations were again made thirty to sixty days postoperative. In two of the dogs the duodenal ileus increased and the delay in evacuation of the gallbladder increased. In two dogs all signs of ileus subsided and with it the evacuation time of the gallbladder returned to normal. In the remaining three dogs the ileus persisted, but the gallbladder emptying time returned to normal.

The authors discuss the relationship of gallbladder emptying to the variations in muscle tone and structure in light of these experiments. They were unable to come to any conclusion, however, but suggest that hypertonicity of the duodenal wall may play a very important part in delaying gallbladder emptying time. They point out, as a result of their roentgen and postmortem examinations, that as long as the gastric and duodenal peristaltic deficiency can meet the increased load of obstruction there will be no intestinal stasis.—*P. J. Hodes.*

ROENTGEN AND RADIUM THERAPY

Blass, G., and Goldhammer, H. Zur Röntgentherapie der klimakterischen Beschwerden. (Roentgen treatment of climacteric symptoms.) *Strahlentherapie*, 1933, *46*, 119–129.

Roentgen therapy of climacteric disturbances either after the natural menopause or after surgical castration has proved very effective. The mechanism of this action is not understood. It has been attributed by some authors to an action on the hypophysis, and the hypophyseal region is often irradiated. Holzknecht claims that there is increased secretion of the hypophysis during the climacteric which is favorably affected by roentgen treatment and this is shown by increased excretion in the urine of hormone A, a hormone produced by the anterior lobe of the hypophysis which brings about the maturation of follicles.

In order to test this theory the authors irradiated 8 patients with climacteric symptoms and determined the excretion of hormone A in the urine. They used 170 kv., 3 ma., secondary current, 0.5 mm. zinc and 1 mm. aluminum filter and 30 cm. focus-skin distance. Several series were given over two temporal fields and in some cases a field in the middle of the forehead. The interval between treatments was one day. The surface dose was about 4 H (200 r) and the minute dose 25 to 30 r.

This irradiation of the hypophysis did not particularly affect the excretion of hormone A in the urine. The increased excretion of hormone A may persist long after the climacteric symptoms have stopped spontaneously or under roentgen treatment. There does not seem to be any direct relation between the excretion of hormone A and climacteric symptoms.—*Audrey G. Morgan.*

Saltzstein, Harry C., and Topcik, Aaron A. The treatment of carcinoma of the cervix in Detroit, Michigan. *Am. J. Cancer*, April, 1933, *17*, 951–961.

In Detroit, the Department of Health instituted a city-wide follow-up system for the study of cancer. The authors report some of the data obtained relative to carcinoma of the cervix from 1928 to 1930 inclusive.

Such a follow-up system has several defects which are: (1) rather poor description of the extent of the local lesion, (2) pathological grading was too varied to be of value, (3) histories somewhat incomplete as to duration of symptoms and as to existence of precancerous lesions, (4) records of radiation therapy not sufficiently detailed to be of value.

However, there are many advantages to such a method of study: (1) The data obtained show the course of the cancer patient as treated in general hospitals in contrast to those treated in specialized cancer institutions. (2) Follow-up examinations of the patient by the physician who sees only a few cancer cases for the year are made possible. (3) Patients may be followed through several hospitals. (4) A much larger number of cases may be studied than any individual physician or institution would see, except over a period of several years (154 in 1928, 141 in 1929, 127 in 1930); 88.6 per cent were followed for three years.

Charts are given showing methods of treatment, details of the follow-up, absolute survivals, first symptom, character of bleeding, duration of symptoms and incidence of cancer following adequate treatment of cervical lesions. The data revealed by the charts show comparable figures with statistics compiled from various individuals reporting such data, 45 per cent being alive after one year; 30 per cent after two years; 22 per cent after three

In view of the fact that such a large percentage of cases are well advanced within a few months, and because cancer week publicity brings about little or no increase in the early cases seen, the authors agree with P. Brooke Bland and others that any advance in the control of cancer of the cervix will come by the eradication of precancerous lesions. This may be accomplished chiefly by improvement in the character of obstetrics practiced throughout the community.—*J. H. Harris.*

Simon, Stefan. Zur Bewertung der Strahlenwirkung bei papillären Ovarialtumoren. (Value of irradiation in papillary ovarian tumors.) *Strahlentherapie*, 1933, *46*, 444–468.

It is harder to determine the boundary line between benign and malignant tumors in the ovary than elsewhere. The author reviews the literature on the subject and describes 6 cases of his own in which irradiation was used, alone or in association with surgery. The tumors were papillary ciliated epithelial tumors or pseudomucinous cystomas. Histological pictures are given. The clinical picture of the two forms was the same.

The tumors were not sensitive to small amounts of radiation. Repeated irradiation with the amounts used for malignant tumors was necessary to produce results. No routine dosage can be given; it depends on the individual case. The author worked with a symmetry apparatus, 175 kv. maximum, 3 ma., 0.5 mm. zinc and 2.0 mm. aluminum filter. In circumscribed tumors the rays were concentrated on the tumor; in diffuse ones the abdomen was divided into four quadrants which were irradiated perpendicularly. The size and number of the fields depended on the size and surface extent of the tumor. From 45–65 per cent of a skin erythema dose was given per field at each treatment (250–350 r without secondary irradiation). The effective dose at 10 cm. depth was 90–110 per cent of a skin erythema dose (500–600 r without secondary irradiation). This dose was generally given within a week and if necessary repeated two or three times within a year. In 2 cases radium was also used, applied inside the vagina and directed toward the lateral walls of the pelvis.

In 4 cases primary irradiation was given. One patient recovered without further treatment, one had to be operated on afterward and 2 died. These patients did not die until years after the irradiation, however, and in one case further irradiation was refused. One of the other patients was given prophylactic irradiation after operation and remained well; in the other case irradiation was given for a recurrence. After marked improvement the patient stopped coming for treatment and returned in hopeless condition after two years. In these cases apparently benign tumors are sometimes followed by malignant recurrences.

From his experience and the results reported in the literature the author concludes that in operable cases operation is to be preferred to primary irradiation but that prophylactic after-irradiation should be given. Intermittent short irradiations should be given. A dose of 500–700 r measured in air is given at the focus and repeated once or twice in the course of a year. If the tumor is inoperable a part of the mass should be removed to make later irradiation easier. If such operative reduction is impossible, intensive irradiation should be given. The irradiation may have to be continued over a long period which can be done with careful dosage.—*Audrey G. Morgan.*

Püschel, Arnold. Die Röntgenbehandlung der Myome und hämorrhagischen Metropathien mit einem Bauchfeld. (The roentgen treatment of myomas and hemorrhagic metropathies over a single abdominal field.) *Strahlentherapie*, 1933, *46*, 346–354.

Kroenig and Friedrich in 1915 showed that it is possible to apply the ovarian dose at one time through a single skin field. This "new Freiburg method" was not generally adopted and has been almost forgotten.

The author has used it in 88 cases and on the basis of his experience recommends it highly. He uses a focus-skin distance of 40 cm., a field 10×15 cm. in size, a filter of 0.5 mm. copper, a half-value layer of 0.95 mm. copper and a surface dose of up to 600 r. This method simplifies castration treatment, makes accurate dosage easier and is extremely well borne by the patient. A supplementary posterior field had to be used in only a few cases in which the patients were very obese or had very large myomas.

Dosage can be based on the tables of Kadisch or Schneider. In hemorrhagic metropathies in women over forty years of age and in small myomas perhaps dosage 10–20 per cent smaller than those indicated in the tables may be given.—*Audrey G. Morgan.*

Pfahler, George E. Irradiation in the treatment of bone tumors. *Am. J. Cancer*, June, 1933, *18*, 318–344.

A report of the method of treatment of 8 different groups of bone tumors is given. In general, the treatment is surgery, irradiation and a combination of irradiation and surgery. For metastatic malignancy, primary in other tissue than bone, irradiation is the procedure of choice. For periosteal fibrosarcoma irradiation, possibly followed by surgery is the author's advice. Osteogenic tumors are best treated by irradiation followed by amputation. Inflammatory lesions where pus is not present respond well to irradiation. Benign giant cell tumors do well under irradiation. Malignant angiomata should be irradiated, probably to be followed by excision or amputation. Ewing's sarcoma and myeloma are best treated by irradiation.

The article contains summaries of several previous articles by the author giving case reports and statistical tables. The results of leading radiologists are freely quoted throughout the paper.

High voltage rays filtered through 0.5 mm. Cu, giving 100 per cent erythema dose into the tumor as rapidly as possible and maintaining this dosage by the saturation method for fourteen to twenty-one days has given the best results in the authors hands.—*J. H. Harris.*

Cutler, Max. The treatment of carcinoma of the cervix with small quantities of radium. *Surg., Gynec. & Obst.*, Oct., 1932, *55*, 481–486.

The author describes his technique which is based on the principles propounded by Regaud of prolonged irradiation with smaller amounts of radium.

In regard to histologic varieties, Cutler states that 3 per cent of the cases are adenocarcinomata—a less radiosensitive type—and 97 per cent are epidermoid carcinomata. The radiosensitivity of this latter group varies from the grade 1 of Broders to the highly anaplastic type.

The author employs morphine and scopolamine as an anesthetic. The usual aseptic precautions are observed; 50 mg. of radium filtered through 1 mm. of platinum in an applicator 5.4 cm. in length is introduced into the cervical canal and 30 mg. of radium, filtered through 1 or 1.5 mm. of platinum is applied simultaneously in the Curie culpostat in the vaginal vault. A total of 8,000 mg-hr. is thus administered in a little over five days.

External irradiation is routinely administered promptly after the internal irradiation by means of a 4 mg. radium pack at 10 cm. distance, filtered through the equivalent of 1.5 mm. of platinum. Seven portals are used, each field receiving 30,000 mg-hr. over a period of twenty-six days. External irradiation is sometimes administered by roentgen radiation, employing 200 kv., 5 ma., 5 cm. distance through 4 portals, 600 r being delivered in divided doses through each portal. Ordinarily, internal irradiation is administered first, although in the following groups the use of external radiation as the initial procedure is preferable: (1) in advanced lesions in which the cervical canal cannot be located; (2) in bulky papillary lesions so filling the vagina that there is no room for a vaginal application; (3) in advanced cases with marked weakness and secondary anemia; (4) in cases where there is pronounced secondary infection.

Results are quoted as reported by Lacassagne of 75 per cent cures in 50 per cent for group 2, and 25 per cent for groups 3 and 4 (classification recommended by the Cancer Committee of the League of Nations). Healy reported 55 per cent five year cures in the early cases. Wood reported 53.1 per cent five year cures in groups 1 and 2, and Heyman reported 44.4 per cent cures in the operable cases. Lacassagne, has shown how the average five year cures have risen from 10 per cent in 1919 to 35 per cent in 1924 due to improved technique. Cutler does not report his own results. —*J. H. Vastine.*

Unseld, E. Umstimmung durch Röntgenbestrahlung bei hartnäckiger Diphtherie der Scheide. (Successful roentgen treatment of a case of stubborn diphtheria of the vagina.) *Strahlentherapie*, 1932, *45*, 355–358.

A woman of forty had a stubborn case of diphtheria of the vagina without any general symptoms. True diphtheria bacilli could be cultivated from the ulcers in the vagina. Treatment by intramuscular injection of 16,000 units of antitoxin had no effect. The local application of serum was also ineffective. After eight weeks' treatment diphtheria bacilli could still be cultivated. Two menstrual periods occurred during the treatment. There were no general symptoms during the periods either, but after each one the vaginal lesions were more extensive than before.

Roentgen treatment was given on the theory that it would stimulate the local and general defensive forces of the body. One vulvar field was irradiated at one time with 30 per cent of a skin erythema dose. The bleeding membranes in the vagina disappeared completely and after nine days diphtheria bacilli could no longer be demonstrated. Four weeks later the patient was re-examined. The mucous membrane was normal and no diphtheria bacilli could be cultivated.

The results of irradiation are not due to the action of the rays on the bacilli, but the destruction of many blood and tissue cells sets free a large amount of defensive substances which bring about a transformation in the defensive forces of the body. It is probable that irradiation can be used successfully for treatment of diphtheria carriers.—*Audrey G. Morgan.*

Barringer, B. S. The technique of the suprapubic implantation of radon seeds in bladder

carcinoma. *Surg., Gynec. & Obst.*, Oct., 1932, *55*, 487–489.

The author recommends the use of radon implants in the treatment of carcinoma of the bladder, the strength of each seed being between 1 and 1.5 millicuries. The cystoscopic approach is used only for small tumors, whether infiltrating or papillary, and only if the tumor is easily reached. The suprapubic method of approach is the one of choice. With the latter method the author reports an operative mortality of only 4 per cent.

Spinal anesthesia is used and a mid-abdominal incision is made. If the tumor is papillary, the papillary portions are removed by some form of cautery, so as to expose the tumor base. If the tumor is flat and the surface is sloughing and ulcerated, a light cauterization should be done, in a measure to control the infection. Following cautery, the radon seeds are implanted, at least 20 radon seeds being necessary to accurately treat a large tumor. In making implantation no attention is paid to the urethral orifice even if the tumor is directly over one or both.

Barringer reports on 98 cases, of which 52.9 per cent of the papillary and 43.1 per cent of the infiltrating carcinomata were regarded as controlled, of which 43.0 per cent and 29.7 per cent respectively were for periods of over three years. There were 27 patients in this series who were well for over five years and there are 22 additional cases which are controlled but have not been under observation for five years.—*J. H. Vastine.*

Markow, D. A., Gorjelik, R. and Liwschitz, S. Über die Röntgentherapie der spinalen Gliose. (Roentgen treatment of spinal gliosis.) *Strahlentherapie*, 1932, *45*, 349–354.

Roentgen therapy of syringomyelia was first used by Raymond in 1905. The author has treated 32 cases in the past four years. He used a helioapparatus with a Coolidge tube, 3.5 ma., 170 kv., filter 0.5 mm. zinc and 1 mm. aluminum, tube 6×8, vertical centering on the vertebra at the affected site. Ninety per cent of an erythema dose was given in three equal treatments with an interval of a day between. The series was repeated after six to eight weeks and if necessary a third series was given after three to five months.

In 15 cases the stubborn paresthesias disappeared. In 17 cases the pain decreased considerably. In 4 cases there was complete restoration of tactile sense. Pain sense was restored much more quickly and completely than temperature sense. In 5 cases there was almost complete restoration of muscle strength and in 3 more cases considerable improvement. In 6 cases there was restoration of decreased or abolished tendon reflexes in the arms and a distinct decrease of spastic phenomena in the legs. There was also an improvement in the trophic skin changes and in 7 cases a certain decrease of muscle atrophies. There was little change in electrical stimulability. In 8 cases there was marked improvement in the disease as a whole though some of them were old cases; in 7 cases a clinical standstill for a long time, in 12 a briefer standstill of four to five months, generally in cases that were unsystematically treated and in 5 cases a progressive course in spite of systematic treatment. Twelve patients were able to take up their work again and one even gave up his invalid pension.

Apparently roentgen treatment may bring about a standstill in the disease and even a retrogression in some cases. It has a particularly good effect on the subjective sensations and vegetative skin disturbances.—*Audrey G. Morgan.*

MISCELLANEOUS

Epifanio, G., and Cola, G. Ricerche sperimentali sulla irradiazione dell'ipofisi. (Experimental study of irradiation of the hypophysis.) *Radiol. med.*, Dec., 1932, *19*, 1338–1363.

A study was made of the functions of the hypophysis by irradiating the gland in rabbits with roentgen rays. Rather hard rays were used—180 kv., 2 ma., copper and aluminum filter.

It was found that complete suppression of the function of the hypophysis causes death. All of the animals irradiated with large doses died in from seven to twenty-eight days; they showed loss of weight, cachexia, anorexia, loss of sexual function, apathy, somnolence and terminal convulsions. There may have been a general toxic action associated with the loss of function of the hypophysis but the changes found on autopsy differed profoundly from those found in animals given general irradiation with large doses. Animals that had been castrated survived even intense irradiation though they showed signs of great suffering.

The experiments show that the hypophysis has a very important effect on bone growth and sex function. The changes in the sexual organs consisted essentially of atrophy of the testicles, uterus and ovaries and weakening or abolition of sexual function. In young animals irradiation of the hypophysis caused arrest of development of the genital organs. In castrated animals the irradiation abolished sexual activity which had been preserved even after castration.

Irradiation of the hypophysis with small doses in young animals caused increased bone growth; in adult animals there was often hypercalcification of the bones and disappearance of the epiphyseal cartilages. Slight enlargement of the epiphyses was seen in the long bones of both adult and growing animals. On irradiation with large doses there were serious changes in the bones resembling those of human rickets.

On irradiation of the hypophysis with large doses there was atrophy or disappearance of the thymus and thyroid; on irradiation with small doses those glands increased in size. The effect on the suprarenals was just the opposite. The other endocrine glands were not affected.

The anterior lobe of the hypophysis was most sensitive to the rays, the intermediate part less so and the posterior lobe only slightly sensitive. The acidophil cells were the most sensitive among the cells. None of the animals showed polyuria, glycosuria, adiposity or bulimia, which confirms the opinion of those authors who attribute these changes to lesions of the nerve centers of the hypothalamic region.

The dose required to destroy the hypophysis was from 90 to 120 per cent of the erythema dose; the stimulating dose varied from 15 to 25 per cent of an erythema dose.—*Audrey G. Morgan.*

Wulff, Helge. Die Senkungsgeschwindigkeit der Erythrozyten bei malignen Tumoren vor und nach Röntgen- und Radiumbehandlung. (The rapidity of sedimentation of erythrocytes in malignant tumors before and after roentgen and radium treatment.) *Acta radiol.*, 1932, *13*, 686–707.

In the first part of his work the author made blood precipitation tests according to Westergren's method in 306 cases of malignant tumor and compared the values with those obtained by several other authors by the same method, the combined material representing about a thousand cases. He finds that while in the majority of cases of malignant tumor there is a pathological increase of precipitation there are also a good many cases, particularly of cancer of the skin and stomach, in which precipitation values are quite normal.

In the second part, the author studied sedimentation in 135 cases after roentgen or radium treatment. He found that the rapidity of sedimentation rises quite rapidly after radium irradiation and that this increased rapidity of sedimentation seems to persist for about a month. In favorable cases the rapidity of sedimentation is decreased or remains unchanged in the later course. In unfavorable cases the later course shows increased sedimentation values. The sedimentation reaction has a certain amount of value in the prognosis of cases of malignant tumor treated by irradiation.—*Audrey G. Morgan.*

Reinhard, M. C. An analysis of the factors entering into radium pack intensities. *Am. J. Cancer*, Jan., 1933, *17*, 136–141.

A study was made of the intensities of radium arranged in three different ways in a pack. Also the intensities with wax spacing, air spacing, and air spacing with brass walls backed with lead and lead walls alone were studied. The arrangement of radium in packs was: (1) four tubes adjacent, (2) four tubes parallel but 2 cm. apart, and (3) with the entire tray filled with radium tubes.

It was found that the intensities decreased rapidly as the areas irradiated were enlarged. There was an increase in intensity when air spacing was compared with wax spacing. In part, this was due to a soft irradiation which was absorbed by the wax. With air spacing, these soft rays were removed by copper filters placed immediately over the ionization chambers.

The influence of the walls confining the radium beam at 6 cm. radium skin distance was found to be rather marked. Using the intensity without a confining wall as 100 per cent, the intensity with brass walls was 116 per cent and with lead walls it was 128 per cent. This was due to the secondary irradiation from the confining walls and was removable with 0.5 mm. Cu filter.

A study of the size of the irradiating surface showed that the field size was insignificant compared with the influence of the radiating area.—*J. H. Harris.*

Bonanno, A. M., and Verano, G. Irradiazione della catena gangliare simpatica dorsale e influenza sullo stomaco. (Irradiation of the dorsal chain of sympathetic ganglia and its effect on the stomach.) *Radiol. med.*, Jan., 1933, *20*, 58–94.

The authors made series of diagraphs of the stomach after roentgen irradiation of the 6th, 7th and 8th dorsal segments of the chain of sympathetic ganglia in normal individuals and patients with various forms of stomach disease. The technique of the treatment and examinations is described and sketches of the stomach outlines and tables given showing the details of the results. In the majority of cases the irradiation had a distinct effect on stomach function, shown by decreased concentration of hydrochloric acid and increased peristalsis and tonus of the stomach. This effect is brought about by the sympathetic fibers which pass through the 6th, 7th and 8th dorsal roots. This work shows that it is possible to act on the stomach by roentgen irradiation as well as on various diseases in which the chief clinical symptom is a disturbance of visceral sympathetic innervation, such as angina pectoris, and certain skin diseases.—*Audrey G. Morgan.*

Polzien, F. Theoretisches zur elektiven Zellwirkung der Röntgenstrahlen. (Theories in regard to the elective action of roentgen rays on cells.) *Strahlentherapie*, 1933, *45*, 189–198.

The theories that prevail at present in regard to the effects of roentgen rays are based on the idea of an elective action of the rays on different kinds of cells. Different kinds of cells and different individuals within the same kind of cells have varying degrees of sensitiveness to the rays. Cells which are in process of division are more sensitive than those that are not. The body is not made up merely of individual cells, however, but of cell and organ complexes. Those cell groups are most sensitive that have an autonomous existence independent of the organism to a certain extent, such as reproductive cells, lymphoid cells, malignant tumors, granulation cells, etc. The cells of a malignant tumor, for instance, are destroyed by the rays, while the cells of an organ, such as the skin, which is a vital part of the organism show an inflammatory reaction. They are supported in their reaction against the rays by the whole organism. Fractional injuries of the skin can be repaired more readily than those of the more nearly autonomous cell groups. Therefore on fractional irradiation the autonomous cells die while the skin cells are regenerated by the force of the organism as a whole. This is true of the normal skin but in chronic eczema, for instance, the cells have become autonomous to a certain extent and can be killed like tumor cells. In acute inflammations of the skin, on the other hand, the cells have not become autonomous but are in a condition of irritation which is only increased by irradiation.

Neither skin cells nor tumor cells, however, are much affected by rays in vitro which shows that there is some sort of vital connection between even the autonomous cells and the organism as a whole. The author assumes that there is a biological cell center in every cell which keeps up the contact with the whole organism and that it is on this biological cell center that the rays act. When the connection is entirely severed by explantation the rays no longer have a point of action. The connection with the organism is necessary to complete life and as soon as it is severed the cells react like dead material.

This of course is theoretical but as long as we really do not know what life is, symbols are necessary in biology as well as in physics and chemistry.—*Audrey G. Morgan.*

Zwerg, H. G. Uber die Allgemeinwirkung der Röntgenstrahlen mit besonderer Berücksichtigung ihres zeitlichen Auftretens. (The general action of roentgen rays with special reference to the time of its occurrence.) *Strahlentherapie*, 1933, *45*, 297–306.

Changes in the white blood picture are an excellent indicator of the beginning of the action of roentgen rays. Experiments are described in which skin flaps were irradiated in white rats. The rats were kept in specially constructed cages protected against irradiation. Only the skin flaps, about 15 sq. cm. in area were brought outside the cage and irradiated with a dose of 1,800 r. After the irradiation the flaps were immediately sutured back in position. The irradiation produced the characteristic changes in the white blood picture and the animals died after two to nine days. If the skin flap was clamped off with elastic clamps only during the irradiation the effect was the same; if the clamps were left on for thirty minutes after the irradiation the effect was slower but the animals died. If the

clamps were left on 4½ hours the animals lived.

This seems to show that the effect of roentgen rays on the white blood picture is not produced by direct action on the blood-forming organs and probably not by action on the circulating blood for there were only a few blood vessels in the flaps. Apparently the action of the rays is due to the destruction of cells and to the toxins formed by the disintegration of the cells. These toxins are formed during and for about three hours after the irradiation.

Rahm and Koose irradiated skin flaps of white mice in vitro and found that their retransplantation caused severe signs of intoxication in the mice. These experiments serve as a probable confirmation of their results.

Further experiments were made on parabiotic animals which showed that the toxic action is transmitted from the irradiated partner to the non-irradiated one.—*Audrey G. Morgan.*

Herzfeld, E., and Anton, Günther. Tyndallmetrische Serumuntersuchungen bei protrahiert-fraktionierter Röntgen- und Radiumbestrahlung. (Tyndallmetric serum examinations in protracted fractional roentgen and radium irradiation.) *Strahlentherapie*, 1933, *46*, 343–345.

In 1931 Gloor and Zuppinger reported the physiological changes in the blood in protracted fractional irradiation. The object of this article is to report the changes in the degree of dispersity of the hydrophil colloids of the blood serum as shown by the Tyndallmetric method. Low Tyndall values show large size of the particles and high Tyndall values a high degree of dispersity. The sera must be examined within five hours after withdrawal of the blood.

A table is given showing the Tyndall values found in 8 cases of carcinoma. High values were found in some of them and low values in some. It is impossible to say at present to what extent the degree of dispersity is dependent on the general condition of the patient and in what way it is affected by cancer. The Tyndall value did not increase in any of the cases in the course of irradiation. A slight increase in one case lies within the boundaries of possible error. In 3 patients the value did not change and in 5 there was a distinct decrease.

No definite conclusions could be drawn from the refractometric examinations and the viscosity determinations.—*Audrey G. Morgan.*

Flint, H. T., and Grimmett, L. G. A critical note regarding units of measurement of roentgen rays and gamma radiation. *Acta radiol.*, 1933, *14*, 104–106.

The question of units of measurement of dosage in radiation therapy is again occupying attention and Sievert has recently made some proposals for modifying the units now in use. The authors endorse Sievert's criticism of the existing systems but criticize some points in his proposals. They agree with Sievert's suggestion that intensity shall form the basis of measurement of dosage as intensity can be accurately measured.

They note with satisfaction the decision of the International Roentgen Unit Committee to preserve the present roentgen (r) with the modification which allows the intensity of roentgen radiation to be specified in r/min. But they criticize the use of the symbol Ir proposed by Sievert for this unit since this is suggestive of a product. Even if this symbol were ever adopted it would be more appropriate to dose than to intensity.

As for radium dosage, the terms "milligram-hours" and "millicuries-destroyed" give no indication of the intensity used nor any information as to the distribution of the sources or the distances at which they act. This system is merely a confession of inability to measure intensity. The alternative unit, namely "ergs absorbed/cc/sec." at first sight seems to be entirely satisfactory but the experimental difficulties involved in its determination are so great that even Staehl, who made the original investigations, claims only a very low degree of accuracy. The essential value of Staehl's work lies in the fact that it allows comparison of the biological efficiency of different wave lengths, but from a practical point of view the system has little advantage over one which records incident energy in arbitrary units.

Finally they mention the unit "radiation curie (IC)" by which Sievert proposes to measure gamma-ray intensity. This unit is defined as the intensity which obtains at a distance of 1 cm. from a point source of 1 gram of radium filtered through 0.5 mm. platinum. Although it is a very useful unit for approximate calculation it is in no way associated with the r of roentgen therapy and takes no account of the composite nature of radium radiation or of the changes in quality of the radiation with increasing screening. The choice of name is rather unfortunate as the word curie is already used

in quite another connection and the symbol "IC" is open to the same objection as the symbol "Ir" cited above.

They suggest that both symbolism and nomenclature be left undecided, at least until the publication of the work of the International Commission on the correlation of roentgen and gamma-ray units. If this correlation is established they doubt whether there could be a better description of gamma-ray intensity than in roentgens per unit time.—*Audrey G. Morgan.*

SIEVERT, ROLF M. Note regarding units of measurement of roentgen- and gamma-radiation. *Acta radiol.*, 1933, *14*, 107–109.

The author replies to the criticism of his proposed units of measurement made by Flint and Grimmett (see above abstract). He thinks their objection to his symbols Ir, Ic and Imc as being products is to a certain extent justifiable. No such objection has been made however to the earlier medical unit H.E.D. The symbol will seldom or never be used in mathematical-physical formulae and therefore misunderstanding need hardly be feared. The symbol selected should be easy to write, even on a typewriter, and should preferably consist of only one letter—though not one used for any other unit or common mathematical indication. He admits that his symbols are by no means satisfactory but thinks they might be improved by putting certain of the letters in brackets, as I(r) or I(mc). It is true that a statement of the radiation intensity expressed in I(mc) would be incomplete but a statement of radiation in roentgens is also incomplete, which is clearly indicated in the recommendations of the International Roentgen-Ray Unit Committee. When defining a dose it is necessary to give, in addition to the intensity in I(mc), information in regard to the filter and type of applicator (irradiated area, amount of radium, relation between different distances, etc.).

Flint and Grimmett think that it is necessary to await the report of the International Committee on the correlation of roentgen and gamma-ray units. But medical radiology is in urgent need of an unambiguous unit for gamma radiation and for the present there is no harm in different countries trying different units. In this way information may be obtained on which to base the decision of the International Unit Committee.

He believes the choice of the roentgen (r) was unfortunate. A unit of intensity would have been better than one of dosage. It would perhaps also have been better to select as the unit the number of pairs of ions produced per second and cubic centimeter (including the ions produced by the secondary radiation from this air volume) divided by some suitable power of 10, instead of going the roundabout way via the electrostatic unit. The definition would then have indicated more clearly that it is a question of a special ionization effect that has nothing to do with the absolute intensity and the CGS system. But a change in a unit already sanctioned may cause greater inconvenience than the retention of one which, even if it is not a good choice, is nevertheless on the whole a serviceable unit.—*Audrey G. Morgan.*

HERRNHEISER, G. Vorläufige Erfahrungen mit der (protrahiert) fraktionierter Bestrahlung. (Preliminary experience with protracted fractional irradiation.) *Strahlentherapie*, 1933, *46*, 435–443.

There have been some objections to the Coutard method of protracted fractional irradiation that have prevented its general acceptance. Many roentgen therapists as well as patients have been frightened by the intense skin reactions produced, considering them roentgen burns though they are not so in reality. There were some failures in the beginning due to improper selection of cases that were wrongly attributed to the method itself. And it is a long and expensive method.

For reasons of time and economy the author has adopted a modified Coutard method which in some ways is more like Schinz' simple fractional irradiation. In some of the cases he used a minute dose of 7.5 r measured on the skin, so that it required forty minutes to give 300 r. In the majority of cases the irradiation time was reduced to thirty, twenty or occasionally even fifteen minutes. The filter usually used was 2 mm. zinc, in some of the cases 1.2 mm. copper and in 3 cases 0.5 mm. copper. The daily doses, as a rule, were 300 r, sometimes as high as 400 r, and the total dose to a field 4,200–4,800 r. This decrease of time apparently does not increase the intensity of the reaction and does not have a bad effect on healing of the skin and mucous membrane changes. The field should be as small as possible but should extend beyond the edge of the pathological lesion. It must be determined in each individual case

and not as a matter of routine depending on the form of the tube. Some of the cases were irradiated before or after the roentgen irradiation with moderate doses of radium.

Report is made of 48 cases treated in this way. In 22 of them, or 46 per cent, the tumor disappeared entirely and has not recurred in observation times extending to a year; in 14 of them, or a little more than a fourth, the tumor disappeared or decreased greatly but recurred, while in 12 there was no great improvement. There were considerable differences in the results in different locations but as a general rule the less advanced the tumors, the better the results. Sometimes, however, the results were surprisingly good in apparently hopeless cases. As an example, a case of sarcoma of the nose in a young girl is cited. It had brought about extensive destruction of the base of the skull. The tumor disappeared and there has been no recurrence and the patient is in excellent general condition.

The author believes the Coutard method is a great advance in roentgen treatment.—*Audrey G. Morgan.*

Löw-Beer, A. Experimentelle Untersuchungen zur Frage der biologischen Röntgenstrahlenwirkung. (Experimental study of the biological action of roentgen rays.) *Strahlentherapie*, 1933, *46*, 469–516.

Examinations were made of the effect of roentgen irradiation on various cholesterin solutions and on the cholesterin content of the animal and human body. Cholesterin was dissolved in chloroform to a concentration of 0.01 to 0.02 per cent and the cholesterin content determined after irradiation by means of Liebermann's color reaction. In the first six to eight hours after the irradiation there was little or no decrease of the amount of cholesterin. Later there was a decrease, its degree depending on the amount of irradiation. On the use of carbon tetrachloride as a solvent the results were the same qualitatively though somewhat less quantitatively. When benzene, acetic acid and methyl alcohol were used as solvents, the irradiation had no effect on the cholesterin content. The effect was the same with filtered and unfiltered rays.

When male mice were irradiated with a dose of 2000 r there was no change or only a slight decrease of total cholesterin content in a few hours. After twenty-four hours there was a slight increase; after four days there was a considerable increase. When the dose was decreased to 1000 r the results were the same. With 600 to 650 r they were the same except that the increase in cholesterin content was less. Young animals reacted in the same way as adults. When only 300 r was used the results after a few hours were the same as with larger doses. After twenty-four hours there was no increase in the total cholesterin content of the animal and after several days there was a slight increase but by no means as great as with larger doses. When the irradiation was given by the fractional method the increase was greater than when the same amount of irradiation was given at one time. When the spleen was extirpated the results were the same as in normal animals except that with a dose of 300 r there was no change in the cholesterin content even after a long period. When the liver was extirpated there was a decrease of the total cholesterin content twenty-four hours after irradiation.

Individual organs were examined for their cholesterin content with and without irradiation and the cholesterin content of the blood also determined. There was a decrease in blood cholesterin four hours after irradiation. The liver and spleen examined at this time did not show any change. Twenty-four hours after irradiation there was a decrease of blood cholesterin and an increase of cholesterin in the liver and spleen. After longer intervals the decrease in blood cholesterin was less and the cholesterin content of the liver and spleen was increased. When only 300 r was used there was a change in the results after a short period; in the later results there was no change. The change in the total cholesterin content of the animal and of individual organs and the blood after roentgen irradiation is to be attributed to storage of cholesterin in the organs or in the reticuloendothelium of individual organs.

The effects of roentgen irradiation on the cholesterin content in man are not uniform. In a number of cases there was a decrease; in other cases of the same diseases there was no change. The change in cholesterin content after irradiation does not seem to be specific either for organ or for disease. There seems to be a certain connection between changes in the cholesterin content of the blood in man and roentgen sickness but it is not justifiable to assume that changes in the cholesterin content

are the only cause of roentgen sickness. Experiments in the treatment of roentgen sickness are discussed. The patients were given large amounts of hypertonic salt solution and cholesterin-free fat or oil by mouth and hypertonic sugar and salt solutions intravenously. The results were good in most cases.—*Audrey G. Morgan.*

CALÒ, A. Über das Verhalten des retikuloendothelialen Apparates bei Bestrahlung von Geschwülsttieren. (Effect on the reticuloendothelial system of irradiation of tumor animals.) *Strahlentherapie*, 1933, *46*, 529–549.

When white mice are given general irradiations with small doses of roentgen rays their resistance to the growth of transplanted tumors is increased. This increased resistance develops gradually. Among the conditions of experiments tested it reached its maximum when the tumor transplantations were made about a month after the irradiation. White mice given preliminary irradiation in this way showed signs of increased function of the reticuloendothelial system. These changes consisted in the formation of histiocytic foci in the liver, a diffuse hyperplasia of Kupffer's stellate cells, the development of similar pictures in the kidneys and lungs and a hyperplasia of the reticulo-endothelial system of the spleen.

When the tumors were transplanted first and the mice given general irradiation ten to twenty-three days later the irradiation had no appreciable effect on the tumors. There were likewise no changes in the reticulo-endothelial system of these animals that could be definitely attributed to the irradiation. Mice that were inoculated with tumors and given intense local irradiation of the tumors thirteen to twenty days later did not show any effect on the growth of the tumors. There were few or no signs of change in the reticulo-endothelial system in this series of animals. With the largest dose used, about 6 H.E.D., there were only signs of a toxic action.—*Audrey G. Morgan.*

UHLMANN, ERICH. Experimentelle Untersuchungen über den Einfluss der Ernährung auf die Strahlenempfindlichkeit tierischen Gewebes. (Experimental study of the effect of diet on the sensitiveness of animal tissues to irradiation.) *Strahlentherapie*, 1933, *46*, 550–563.

Experiments on rabbits are described in which sensitiveness to irradiation was tested by means of epilation. It was found that epilation was brought about with much lower doses in animals that were fed on a diet of oats exclusively than in those fed on a normal mixed diet of oats, hay, beets and occasionally potatoes, that is, the skin is more sensitive on a diet that has an acidotic action on the blood. The cause of this increased sensitiveness on acid diet is not known.—*Audrey G. Morgan.*

SCHMITZ, W., and SCHAEFER, H. Ueber den Einfluss der Röntgenstrahlen auf den Nervenaktionsstrom. (Effect on the action current of nerves.) *Strahlentherapie*, 1933, *46*, 564–567.

The method of registering the action currents of the sciatic nerves of frogs is described and the details of the technique of the roentgen irradiation given. One sciatic nerve of an animal was irradiated and the other used as a control. The results show that irradiation with therapeutic doses does not have any direct primary effect on the nerves.—*Audrey G. Morgan.*

SHDANOW, D. A. Röntgenologische Untersuchungsmethoden des Lymphgefässsystems des Menschen und der Tiere. (Roentgenologic investigation of the lymphatic systems of human and animal subjects.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1932, *46*, 680–691.

The author prefers injections of mercury for general purposes and of finely ground white lead or collargol for the roentgen study of the meninges. The value of this method of the study of the anatomy of the lymphatic system is emphasized.—*E. T. Leddy.*

FRIED, CARL. Sterilization durch einzeitige Ein-Feld-Bestrahlung. (Sterilization by a single one-field irradiation.) *Strahlentherapie*, 1932, *45*, 553–562.

The author discusses the various methods of multiple field irradiation that have heretofore been used for sterilization. As it is desirable to have the shortest irradiation time possible he proposes a single exposure, one-field irradiation which he has been using since 1920. Before beginning the irradiation the distance from the symphysis to the sacrum is determined. In the great majority of cases it is 20–21 cm. Then the distance from the symphysis to the portio is measured; in normal cases it is 9.5 to 10.5 cm. As a control, the distance from the sacrum to the portio may be measured.

The field is a reversed trapezoid, the long side of which in metropathies and small myomas lies between the anterior superior spines of the ilium; in larger myomas it may be moved up as far as necessary. The two lateral sides run along the folds of the groin and the short side along the lower border of the symphysis. Before it is bounded by leaded rubber plates the lower part of the abdomen is compressed by covering it with a piece of cardboard which is as broad as the body and extends from the lower border of the symphysis to the umbilicus; it is fastened in place by a leather girdle 14 cm broad and 2 mm. thick. The central ray is directed on a place in the midline about 1½ to 2 finger breadths above the upper border of the symphysis; 0.5 mm. copper and 1 mm. aluminum filter, 180 kv., 4–6 or 8 ma. With a new Metwa-Metalix tube with 4 ma. the necessary dose can be given in eighteen to twenty minutes. The distance may be 40 or 50 cm. depending on the measurements of the patient; the number of milliamperes depends on the condition of the patient; if she is very weak from loss of blood it may be necessary to shorten the time. The shortest time the author has ever used for a successful sterilization was fifteen minutes. The average surface dose is 450–490 r primary radiation, or 600–640 r including the secondary radiation. With this method there is no injury of the surrounding organs and only a slight to moderate skin reaction.

The method of calculating the deep dose from the surface dose is described.—*Audrey G. Morgan.*

Biro, Stefan. Ein Fall von Fruchtschädigung durch Röntgenstrahlen. (A case of injury of the fetus by roentgen rays.) *Strahlentherapie*, 1932, *45*, 549–552.

Many cases are reported in the literature of injury of the fetus by roentgen irradiation given during pregnancy. Murphy reports 106 cases in which roentgen irradiations were given during pregnancy by the best known gynecologists of America. Among the 74 fetuses delivered at term 25 showed deformities; 14 of them were microcephalic.

The author describes a case in a woman of thirty-two; she had had two previous pregnancies both ending in abortions. Her menses stopped from November, 1929 to January, 1930. In January she had hemorrhage for several weeks and on February 6 normal menstruation. In March she had no period. In April irregular hemorrhage began again which lasted until the end of July and sometimes contained clots. She went to a hospital in Paris on May 5 for these symptoms and was given roentgen irradiation which was repeated in a provincial hospital after her return to Hungary. Here a diagnosis of tumor of the uterus was made and operation advised. She then came to the author's clinic in Budapest showing pigmentation of the skin of both lower quadrants of the abdomen from irradiation. She was kept under observation nine days on the suspicion of extrauterine pregnancy but as it was found at the end of that time that the pregnancy was intrauterine she was dismissed. Labor began on December 5 and she was delivered of a girl who was very small; length 39 cm., weight 1,550 gm., circumference of the head 25 cm. On account of the irregular hemorrhage at first it was impossible to determine the exact beginning of pregnancy but the child did not show any signs of prematurity. Even a prematurity of ten days which might have been possible from the history would not have caused such an extremely small head.

A written report from the mother when the child was two years old stated that she was not yet able to walk or talk.—*Audrey G. Morgan.*

Granzow, Joachim. Über das Verhalten der Frucht bei extra-genitaler Radiumbestrahlung in der Graviditat. (Effect on the fetus of extragenital radium irradiation during pregnancy.) *Strahlentherapie*, 1932, *45*, 538–548.

Forty-five guinea pigs were irradiated with radium over the heart region in different stages of pregnancy. The doses and the size of the fields varied. A primary filter of 0.3 mm. silver was used in all cases and in some of them a secondary filter of 1.5 mm. brass.

Among the 45 pregnant animals 5 died within a short time with the pregnancy intact. Of the other 40, five carried the pregnancy to normal term and each of them delivered 2 young of normal form. Of these 10 young animals, 8 died within the first thirty-three days after birth; autopsy did not show any pathological changes. Of the other litter, one died after 140 days and the second was killed and found normal. None of these 10 young animals produced offspring.

In 35 of the 45 cases there was premature interruption of the pregnancy within one to forty days after the irradiation and no living young were obtained. This interruption of pregnancy was not brought about by irradiation of the genital organs but of the heart. The time between the irradiation and the abortion was shorter the larger the dose and the more advanced the pregnancy. There were some exceptions to this general rule, however. The filtration of the preparation, the size of the field irradiated, the amount of injury of the heart and ovaries resulting from the treatment and the length of time the animals survived after the irradiation did not apparently have any effect on the time of occurrence of the abortion.

The experiments show that extragenital irradiation of the heart in pregnant animals causes premature interruption of the pregnancy in a large percentage of the cases.—*Audrey G. Morgan.*

Drips, Della G., and Ford, Frances A. The study of the effects of roentgen rays on the estrual cycle and the ovaries of the white rat. *Surg., Gynec. & Obst.*, Nov., 1932, *55*, 596–606.

In giving doses of approximately 1/15 to 1/10 human erythema dose at the level of the ovaries, corresponding to the low dosage of radiation used in treatment of certain ovarian dysfunctions of human beings, the most frequent physiological effect observed in the rats consisted of the skipping of one or two estrual periods; at times the stage of cornification which was present at the time of irradiation, and the subsequent interval, were prolonged. The only histological effect noted was congestion of the ovary.

In giving sufficient irradiation to produce sterilization of the ovaries the authors found great difficulty in securing uniform destruction of functioning ovarian structures with any one exposure to roentgen rays. This is probably partly due to individual variations in sensitivity of the follicles in different animals. A certain proportion of small follicles and primary oöcytes apparently is uninjured even by the most intensive irradiation, and during the time of their development cyclic activity of the uterus continues, although animals are usually not fertile except for a brief period immediately after irradiation. The results of irradiation in their experiments confirm the fact that with complete atrophy of all functioning structures no cyclic activity occurred. This is apparently not in accordance with the findings of Parker and von Schubert, both of whom have reported a continuation of the estrual cycle after all of follicular structures in the ovaries of mice had been destroyed by irradiation. A peculiar hyperplastic structure was discovered in the ovaries of rats killed later after exposure to roentgen rays, and in these rats a late return of the estrual cycle was found to occur.—*J. H. Vastine.*

Fuhs, H., and Politzer, G. Über die Wirkung der Radiumstrahlen auf die Zellteilung. (The effect of roentgen rays on cell division.) *Strahlentherapie*, 1932, *45*, 359–364.

Alberti and Politzer in 1923 studied the effect of roentgen rays on cell division in the cornea of salamander larvae. Shortly after the irradiation abnormal karyokineses occurred and then after a free interval they occurred again. At that time the effect of radium rays was not tested as it was necessary to keep the larvae quiet and anesthetics affected cell division. It has now been found, however, that a 1:50 chloretone solution has no effect on cell division so the action of radium rays was tested using this anesthetic. The details of the experiments with dosage and length of irradiation time are given. It was found that beta and gamma radium rays have the same effect on cell division as roentgen rays. It could not be definitely determined whether the quantitative effect of the radium rays corresponds physically to that of an equal amount of roentgen irradiation.—*Audrey G. Morgan.*

Adler, Karl, and Adler, Margarethe. Calcium und Kaliumstoffwechsel unter den Einfluss der Röntgenstrahlen bei Kaninchen. (The effect of roentgen irradiation on calcium and potassium metabolism in rabbits.) *Strahlentherapie*, 1932, *44*, 481–488.

Roentgen irradiation in rabbits causes a considerable decrease in the calcium and potassium content of the skin and blood serum. The object of this investigation was to determine how the minerals that disappear from the skin and blood are disposed of. They can either be excreted in increased amounts or stored in some organ in the body.

The metabolism experiments in rabbits are

described and tables given showing the details of the results. Water metabolism had to be tested also as the excretion of salts depends on the amount of water excreted.

It was found that after irradiation there is increased excretion of water. In two animals in which this did not occur the retention seemed to be due to decreased food and fluid intake. There was a marked increase of calcium excretion for the first twenty-four hours after the irradiation, followed for the next few days by retention. The excretion of potassium was increased for the first four or five days after the irradiation. The maximum excretion frequently did not take place until the third day when the excretion of fluid was also greatest. After that there was also retention of potassium.—*Audrey G. Morgan.*

Hartoch, Werner, and Israelski, Martin. Zur Wirkung der Röntgenstrahlen auf die Funktion sezernierender Organe. Lebendbeobachtungen in Luminiszenzlicht. (Effect of roentgen rays on the function of secreting organs. Observations on living animals in fluorescent light.) *Strahlentherapie*, 1932, *44*, 557–574.

Capillary microscopy has proved particularly valuable in studying the function of the skin and internal organs. The authors used the method of intravital microscopy, staining the organs with fluorescent stains and then illuminating them with ultraviolet light.

Frogs were used for the experiments; 75 of them were given total irradiations with roentgen rays or partial irradiations of the liver region. There was no difference in the effect of the total and partial irradiations. The frogs were given doses of from 10 r to 4,000 r at one time. Frogs that were given the most intense total irradiations and kept under observation for thirty-five days survived, while warm-blooded animals died with a fraction of this dosage.

Excretion was examined in these animals and 30 controls by intravital microscopy with the fluorescent method. This method shows the course of the excretion of stain in the bile capillaries and also to a certain extent circulatory conditions in the liver. Impairment of excretion of stain after roentgen irradiation was shown by decreased filling of the bile capillary network and by differences in the filling of the capillaries in different areas of the liver. There was inhibition of excretion by doses of from 500 r upward. There was no increase of excretion in any case. The action of the rays became manifest within five hours after the irradiation and persisted for at least three weeks. With doses of 4,000 r it was still distinctly visible after five weeks and possibly irreversible. The intensity of the liver injury increased with increased dosage.

Intravital microscopy will probably prove valuable in working out a scale of sensitiveness to roentgen rays of the excretory functions of secreting organs.—*Audrey G. Morgan.*

Maruyama, Kotato. Experimentelle Untersuchungen über Röntgenkater und Röntgentod. (Some experimental studies of "roentgen sickness" and "roentgen death.") *Fortschr. a. d. Geb. d. Röntgenstrahlen*, July, 1932, *46*, 85–94.

Maruyama concludes from his investigations on roentgen effects carried out on guinea pigs that (1) the changes produced in the organism differ with the method of radiation; (2) by irradiation at definite intervals an anaphylactic or allergic reaction is evoked corresponding to the so-called "roentgen sickness" of Gauss; (3) continual irradiation results in a gradual exhaustion of the organism; (4) death from interrupted irradiation is an anaphylactic shock death caused by an acute necrotizing destruction of cells necessary to maintain life, and (5) death as a result of continued irradiation is an exhaustion death coming on from more slowly progressing degenerative changes in vital organs.—*E. T. Leddy.*

Franke, H. Die Verwendung des Röntgenpapiers für Aufnahmen. (The application of roentgen paper to roentgenologic exposures.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Sept., 1932, *46*, 301–313.

For physical reasons it is impossible to produce the same detail in a sensitive photographic surface as in a film. But recently photosensitive papers have been developed specially for roentgen-ray purposes and their blackening and contrast, their general sensitiveness gradation, have been improved. Photometric curves obtained by the Hunter and Druffield method utilizing the Goldberg densograph have been obtained for such paper by Pulfrich. Comparison shows that for a logarithmic value of paper of 1.5 (numerically 1.30) the logarithmic value

for film is 2 (numerically 1.100). The correct arrangement of the paper in the cassette is, commencing on the side of the roentgen tube, paper, intensifying screen, and, preferably, the back screen of a pair of screens. The author explains how best to combine screen film and paper if it is desired to obtain two negative paper pictures or a duplicate paper and film picture. Since in an exposure with paper a considerable part of the active light is supplied by reflection of the screen illumination to the lower layer of paper, it is necessary to allow a considerably greater exposure than when working with film. Optical estimation of films as obtained by the use of screens enabling the operator to intensify the object by darkening or lightening the illuminating apparatus is a fundamental advantage of such surface roentgenograms. There is no great difference between film and paper if the degree of contrast of a film picture is based on the maximum contrast of paper. The attempt is being made to apply the experimental results of Goldberg's detail curve to roentgen film. Within certain limits it is possible to control a paper picture during development by retardation of an overexposed part. Later intensification or reduction is not possible. A special advantage of paper lies in reproduction of the original picture for illustrative purposes. For the successful use of paper exact knowledge and technique in the photographic processes are required.—*E. T. Leddy.*

Juris, Kalman. Das Negativpapier in der Röntgentechnik. (The application of negative paper to roentgenographic technique.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Sept., 1932, *46*, 313–321.

Three samples of commercial negative paper were compared with usual double-coated roentgen film. The restricted gradation of the negative paper was demonstrated by means of photometric curves. The Bronkhorst method of investigation showed that to allow good detail the fundamental blackening factor must not be greater than 1.2 to 1.5. The range of blackening of the papers complied with this requirement. The value of the detail of one negative paper was within and equal to the lower and middle ranges of gradation of the comparative film, but in the higher ranges (in the range of visible light) each film was superior to the negative papers. The sensitiveness of the negative papers when used with ordinary intensifying screens was less than that of the film. With respect to the absence of fogging (developmental and dark room fogging) two were less liable than the film. Freedom from tendency to fog is of utmost importance as the degree of fogging determines the degree of blackening. With the papers there was much less chance to correct errors of exposure owing to its smaller degree of graduation than in the case of film. The change of sensitivity due to changes in the time of development was about equivalent in paper and film. The change of the slope of the curve with change in time of development showed that the papers were quite equivalent to the film. On the basis of photometric curves the varying properties of the negative papers, particularly under continued illumination (large degree blackening), were demonstrated in relation to the type of the paper surface. With the application of a highly glossed surface the possibility of practical use of negative papers is rendered more extensive and the scale of blackening is decreased.—*E. T. Leddy.*

den Hoed, D., and Woldringh, B. M. Über einige Störungen, welche die Strahlenausbeute einer Röntgenröhre beeinflussen können. (Disturbances affecting the radiation output of roentgen tubes.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Oct., 1932, *46*, 462–465.

The dose per second of a roentgen tube depends on the type of tube and its position in the tube holder as well as on its current supply. The dose from a self-protecting tube when it is supported at its middle point depends on the insulation resistance of the holder and varies with the particular type of tube stand. Since this insulation resistance may vary from external causes it is advisable that the central metal part of the tube be grounded. The measurement of dose either immediately before or during the actual therapeutic irradiation is strongly recommended.—*E. T. Leddy.*

Kögel, G. Zur Problematik der Empfindlichkeit organischer, desmotroper Verbindungen für Röntgenstrahlen. (On the problem of the sensitivity of organic desmotropic compounds to roentgen rays.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Sept., 1932, *46*, 295–301.

Kögel analyzes from a photochemical point of view the reactivity to light and to roentgen rays some of the organic radicals and shows that intermolecular shifts of atoms or groups

of atoms may produce marked changes in the properties of the compounds.—*E. T. Leddy.*

Kögel, G. Zur Frage der Desmotropie organischer Verbindungen und ihrer Empfindlichkeit für Röntgenstrahlen. (On the question of desmotropism of some organic compounds and their sensitiveness to roentgen rays.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Oct., 1932, *46*, 466–469.

In a previous paper Kögel showed that tautomerism caused sensitivity to radiation in some organic compounds. In the present paper he discusses the colloidal form of some compounds in the same regard.—*E. T. Leddy.*

Kudisch, B. M. Über die funktionell-dynamische Methodik der Kardioröntgenologie. (The functional-dynamic method of cardioroentgenology). *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Nov., 1932, *46*, 529–545.

The author has correlated the various enlargements of the cardiac chambers with the type of pulsation seen roentgenoscopically in some charts and tables given in the paper.—*E. T. Leddy.*

Chaoul, H. Ueber ein Verfahren zur gleichzeitigen Herstellung von zwei qualitativ verschiedenen Aufnahmen. (A procedure to produce by one exposure two negatives of different quality.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Nov., 1932, *46*, 554–557.

Two roentgenograms of different quality may be useful to bring out the detail of some structure. Chaoul makes the exposure as follows. In a cassette two sheets of paper are placed with the intensifying screens (Heyden) so that the screens and paper are in the following order: paper, front screen, paper, back (reflector) screen; the time of exposure is prolonged about 20 per cent over that for paper or films and then the paper is developed five minutes. The two negatives are then viewed in a stereoscope to evaluate their difference in quality. Reproductions of roentgenograms in the article indicate the value of the method.—*E. T. Leddy.*

Widemann, Max. Die relative Strahlenausbeute der Röntgenröhre bei Verwendung der Schaltungen nach Greinacher und Witka in einer Röntgenapparatur mit Alternativschaltung. (The relative output of roentgen tubes in the Greinacher and Witka circuits in an apparatus with an alternative connection.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Nov., 1932, *46*, 596–598.

The author found by ionometric and photographic measurements of intensity of the roentgen output of a tube in the Greinacher and Witka circuits a mean relationship of 2:1. The tube in the Witka circuit showed a remarkable regularity of the voltage relationships above 180 kv.—*E. T. Leddy.*

Ott, Paul. Überlagerungsstreifen im Röntgenbild. (Superimposed striations in roentgenograms.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Dec., 1932, *46*, 702–709.

The superimposition of cylindrical, tubular or tube-like images with sharply defined differences of blackening, giving rise to dark and light striations, may occur in roentgenograms and their interpretation may cause error. Since every roentgenogram is merely superimposed images these phenomena may be of the greatest importance in the interpretation of indistinct shadows caused by the multiplicity of the contours of parts of the skeleton. The Mach phenomenon plays some rôle in producing these impressions but is not the entire explanation of their occurrence. They have no relationship to the phenomena described by Köhler and Janus. —*E. T. Leddy.*

Schmitz, W. Experimentelle Beiträge zur Spannungskurvenform an Röntgenapparaturen. (An experimental study of the voltage curve in roentgen apparatus.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Dec., 1932, *46*, 711–718.

Operation of a roentgen tube on a high tension transformer with a mechanical rectifier causes marked deformation of the primary current and particularly of the secondary terminal voltage. This causes oscillations which may cause disturbances in nearby valve machines and, in some cases, in damage to the roentgen tube or valves. The relationships are illustrated by reproductions of oscillograms. The curves from symmetrically arranged roentgen apparatus show generally only slight deviations from the theoretical voltage curves. Disturbances from oscillation in mechanical rectifiers may be suppressed by the insertion of capacity in the secondary of the transformer.—*E. T. Leddy.*

Bouwers, A. Über eine neue Anodenkühlung für Röntgenröhren. (A new method of cool-

ing the anode of a roentgen tube.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, Dec., 1932, *46*, 718–721.

Since modern practice tends to surround roentgen tubes by metal containers direct water cooling of the tube is not possible. In the device described by the author cooling is brought about by radiation of heat into the surrounding air and the absorption of heat by a mass of large size and high heat capacity. The method can be applied efficiently to inclosed tubes using ventilator cooling or to the replacement of the water-cooling system of nonprotective tubes.—*E. T. Leddy.*

Hayer, E. Blutbildbeobachtungen bei Röntgenbestrahlung. (Observations of the blood picture in roentgen irradiation.) *Strahlentherapie*, 1932, *44*, 687–714.

The blood picture was studied during and after irradiation in 35 cases. Tables are given showing the details of the results. There were great differences in the site of irradiation and the size of dosage in the different cases but in spite of that there was a certain degree of uniformity in the effects of irradiation.

After every application of the rays the total number of leucocytes fell. This fall may be preceded by a slight rise for the first few days. It is independent to a great extent of the size of the dose, and, if blood-forming organs are not irradiated directly, depends more on whether the blood-forming organs have been injured previously or not. In cases in which the total leucocyte count has been increased before irradiation, irradiation causes a more rapid and deeper fall of leucocytes, while if the blood picture is normal the fall is slower. But the time required for the fall of leucocytes and restoration to normal does not depend so much on the nature of the disease (except perhaps carcinoma) but depends to a very great extent on dosage.

For instance, in inflammatory diseases irradiated with only small doses in spite of a rapid fall there is just as rapid a rise of leucocytes as soon as the irradiation is stopped and this is particularly true in very stubborn diseases. But if very large doses are used as in carcinoma and polyglobulia it requires very much longer for the old values to be restored. On direct irradiation of the blood-forming organs, that is, the spleen or a large part of the skeleton, the lymphogenous blood-forming organs are found decidedly more sensitive than the myelogenous ones. The myelogenous blood-forming organs can bear much larger doses and do not react so quickly, possibly because they cannot be given total irradiations as easily as the lymphogenous organs.

On the use of small doses there is a very fine regulation by the irradiation. Not only is there a fall in the most sensitive cell group but the kind that had been most increased before and had therefore disturbed cell balance proves particularly sensitive and falls quickly so that balance is restored. This helps to explain the apparently biopositive action of roentgen rays on other kinds of cells. The rise of eosinophil cells on irradiation of asthma cases is an exception to this rule. Apparently there is a predisposition here that is a decided factor. On the use of large doses the conditions are different because they inhibit function very much more.

In cases of polyglobulia only the myelogenous blood-forming organs were irradiated. Here there was an inhibition of production of neutrophil cells that began slowly but was very persistent. The lymphogenous organs were not directly irradiated and showed an increase of cells, perhaps indicating an antagonism between myelogenous and lymphogenous blood production. This increase was seen particularly when the lymphogenous blood-forming organs had shown decreased production before the irradiation. There was a fall of lymphocytes where before the irradiation they had shown hyperproduction as compared with neutrophils.

The conditions are complicated in tumors. In almost all tumors, particularly those of the digestive tract, there are inflammations around the tumor, and in addition to this the blood picture is changed by the toxic products of the tumor itself and by the secondary anemia. Generally the blood-forming organs are seriously injured before the irradiation. Generally on irradiation both the neutrophil and lymphocyte groups fall, and the fall of lymphocytes is proportionately greater the more serious the case. This is of value in prognosis. This does not hold true in lymphosarcoma in which the lymphocyte-producing organs have already been seriously injured.

The effect of the rays on the red blood picture can be demonstrated in polyglobulia in which the long bones are directly irradiated but in other conditions it cannot. In cases in

which the bone marrow is only indirectly irradiated there may be improvements or exacerbations of the red blood picture independent of the severity of the disease or the dose. From the course of the picture in the cases of chronic arthritis and in a case of tumor which was observed for a long time without irradiation it seems that these changes in the red blood picture are dependent on the disease itself rather than on the irradiation.—*Audrey G. Morgan.*

Schreus, H. Der Stand der Oberflächentherapie. (The present status of surface therapy.) *Strahlentherapie*, 1932, *44*, 541–556.

This is a collective review of the methods of dosimetry and technique and of the forms of apparatus used in superficial roentgen therapy as distinguished from deep therapy. The use of Sabouraud-Noiré tablets is discussed and the improved methods of dosimetry with ionometric chambers independent of wave length. In any case the doses should no longer be measured in H, X, S-N or E.D. but in "r" which is the biologically correct measure of dosage. A skin erythema dose is about 500 r. The chambers are rendered independent of the hardness of the rays chiefly by a properly conducting inner layer of the walls and decreased absorption in the walls of the chamber. The various forms of chamber are described.

The ideal dosimetry is continuous measurement on the patient and dosimeters for this purpose have been devised by Hammer and by Schreus. Hardness is measured primarily in terms of the half-value layer, determined by the percentage of weakening in aluminum or copper. A number of instruments for measuring the half-value layer have been devised.

The distribution of the dosage in the skin must be determined chiefly by calculation. It must take into account the increased dosage from secondary irradiation and the decrease in dosage with increasing depth.

Various forms of apparatus are described, including the improved soft ray apparatus and the modern protected tubes. A further improvement is necessary in the angle of inclination which should be about 45° instead of the 20° usually used for diagnostic purposes. When the more acute angle is used there is a sharp decrease of dosage toward the anticathode side of the field which may lead to serious errors of dosage when the measurement is made on the anticathode side.

Methods of obtaining uniform distribution of dosage are discussed. Though many improvements in surface therapy have been made in recent years by physicists and radiologists there are many problems still waiting solution. —*Audrey G. Morgan.*

Stewart-Harrison, R. Weitere Resultate bei protrahiert-fraktionierter Röntgenbestrahlung nebst Bemerkungen über die einfach-fraktionierte Röntgenbestrahlung. (Further results in protracted fractional roentgen irradiation with remarks on simple fractional roentgen irradiation.) *Strahlentherapie*, 1932, *44*, 679–686.

Eight cases of malignant tumor are reported which were given protracted fractional roentgen irradiation. They included a carcinoma of the mucous membrane of the arytenoid region, one of the pyriform recess of the same type, a carcinoma of the tonsil of the skin type, a carcinoma of the base of the tongue of the mucous membrane type, a sarcoma of the tonsil, a carcinoma of the right arytenoid region of the mucous membrane type and a large round cell sarcoma of the turbinate. The diagnosis was confirmed by histological examination in all the cases.

Operation had been possible in only 2 of the cases and in one of these a mutilating operation had been performed. In the other a conservative operation was performed. Protracted fractional roentgen irradiation was given in all the cases. In one case operative removal of the regional glands was necessary later. All the cases were irradiated until a mucous membrane reaction developed. Treatment did not have to be discontinued in any case on account of complications. The dosage varied in the different cases and histories are given with the technique for each case. All the patients have been free of symptoms for at least a year.

There has been considerable discussion as to whether simple fractional treatment does not give as good results as protracted fractional treatment. The author thinks it does not and that it is indicated only in cases where nothing more can be expected than palliative results or in which protracted fractional treatment is contraindicated. Occasionally very good results are obtained however. He describes 2 cases in which the patients have remained free of symptoms for three years. One was a carcinoma of the vocal cord and one a lympho-epithelial carcinoma of the tonsil. In both cases pro-

tracted fractional irradiation was contraindicated on account of the general condition and old age of the patients.—*Audrey G. Morgan.*

Pirkle, H. B. A method of recording roentgen-ray readings. *Am. Rev. Tuberc.*, March, 1933, *27*, 311–314.

A reduced copy of the chest film, photographed on bromide paper, is mounted with the written interpretation, the method offering advantages in the ease with which serial films can be compared, in low cost and in furnishing the referring physician with a copy of the film for his records.—*W. R. Brooksher.*

Bouwers, A. Forschung und Entwicklung auf dem Gebiete der Röntgentechnik. (Research and development in the field of roentgen technique.) *Acta radiol.*, 1933, *14*, 184–196.

The author describes the structure and equipment of one of the new technical laboratories for the study and development of roentgen-ray technique, particularly for work with very high tensions. The walls of the rooms in which intensive roentgen-ray work is being done are hollow and the space filled with barium carbonate; the doors are also lined with a layer of lead sufficient to prevent the penetration of rays. There is a two-story high tension room for tensions up to a million volts. The work carried on by the laboratory is physical research, technical investigations, the invention and improvement of apparatus and the medical use of the rays in diagnosis and treatment.

Recent improvements in roentgen technique are discussed, including metalix tubes which was the first tube made with complete protection for medical practice. This was made possible by the discovery of a method of combining glass with chromium and iron. The principle of divided tension was introduced at the same time and the use of high tension cables with flexible metal mantles. Technical details of the work are discussed and various forms of apparatus illustrated. A bibliography of the publications of the laboratory up to the middle of 1932 is given.—*Audrey G. Morgan.*

Åkerlund, Åke. Einige neue Typen variabler tubenförmiger primärblenden. (Some new types of variable tube-shaped primary diaphragms.) *Acta radiol.*, 1932, *13*, 603–614.

The author calls attention to the importance of effective primary diaphragming, a question that has been somewhat neglected since the technique of secondary diaphragms has come into general use. But even if a secondary diaphragm is also used, a primary diaphragm is required that is easily manipulated and adjustable attached to the screening stand and trochoscope. The author describes and illustrates a series of such diaphragms that he has designed in recent years: (1) a cylindrical type with a circular diaphragm moving longitudinally; (2) a cylindrical type with a double revolving diaphragm disc; (3) a rotary diaphragm ribbon; (4) a pyramid-shaped Iris tube; (5) an eyelid diaphragm with double "lids"; (6) a "pyramid" diaphragm with a "double door" system. He also mentions a new diaphragm designed by the Jarnhs Electric Company of Stockholm.—*Audrey G. Morgan.*

Greenberg, Sidney. Pulmonary roentgenography of small experimental animals. *Am. Rev. Tuberc.*, Feb., 1933, *27*, 137–142.

A technique is described for the roentgen examination of pulmonary lesions in small laboratory animals, which permits interpretation in these animals with the same degree of accuracy that obtains for human beings.—*W. R. Brooksher.*

McKeown. R. M., Harvey, S. C., and Lumsden, R. W. The breaking strength of healing fractured fibulae of rats. V. Observations on a low calcium diet. *Arch. Surg.*, Dec., 1932, *25*, 1011–1034.

Albino rats aged from six to eight months and weighing from 190 to 300 gm. were selected for study. The diet was actually calcium-low and not calcium-free. During healing the fractures of rats on this diet showed a retardation in the calcific and an accentuation in the organic states. Roentgenologically a rarefied callus was shown which would indicate a callus of but little strength. The breaking strength, however, of healing fractured fibulae of rats on a low calcium diet was relatively close to that for similar animals on a standard diet. The result of an absolute increase in the organic elements of the callus was an accentuation of pliability, or elasticity, of the healing callus over that of normal tissue and an exaggeration of the factor of bending before breaking when the determinations of the breaking strength were made on the testing machine. From the

results obtained in rats on the low calcium diet, as compared with those in rats on a low phosphorus diet, it would appear that phosphorus is of more importance to the strength of healing fractures than calcium.—*J. R. Andrews.*

Wallgren, Axel. Zur Kenntnis der biologischen Wirkungen der γ-rays. (Study of the biological effects of gamma rays.) *Acta radiol.*, 1933, *14*, 111–121.

This work, carried out by the author at the Radiumhemmet in Stockholm, is a continuation of previous investigations on the biological action of roentgen and light rays. Special granulocytes (neutrophil leucocytes) were used as the objects to be examined. The irradiation was given with one of the applicators of the Radiumhemmet made up of 34 tubes each containing 5 mg. radium element. The minimum distance between the lower pole of the tubes and the preparations was 3 mm. The filter was equivalent to 1 mm. lead. The specimens were kept at a temperature of 37°C. during the irradiation.

Fifteen minutes' irradiation caused immobilization of some of the cells but when the irradiation was stopped they soon regained their normal motility. On irradiation from half an hour to an hour a great many cells were immobilized but most of these became active again when the irradiation was stopped. The same effect was seen after irradiation for an hour and a half but it was noted that after fifty minutes some of the cells were dead or undergoing disintegration. When the irradiation was continued for from two to two and a half hours most of the cells were severely injured, dead or undergoing disintegration when it was stopped.

The results of the experiments with gamma rays correspond in every way to those of the former experiments with light rays. The first demonstrable biological effect of irradiation with roentgen rays, light rays, or gamma rays, was immobilization of the cells and structural changes did not occur until later.—*Audrey G. Morgan.*

Kadrnka, S. Ostéomyélographie expérimentale par voie endoveineuse. (Experimental intravenous osteomyelography.) *Acta radiol.*, 1933, *14*, 148–160.

In continuation of previous work on the opacification of deep organs by means of opaque colloids, the author reports in this article his experiments in rendering the bone marrow opaque by intravenous injections of thorotrast. The reticulo-endothelial cells of the bone marrow, like those of the liver and spleen, have a capacity for filtering out of the blood insoluble particles that are suspended in it. In the first phase, the thorotrast is fixed by the endothelial cells and in the second it passes rapidly into the reticulum where it remains for some months. The roentgenogram shows opacification of the bone marrow in the form of a homogeneous veil of fine uniform granulations. Finally, in the third phase the thorotrast cells accumulate in the lymphatic nodes and are eliminated from the bone marrow. The roentgenogram then shows granules of unequal size irregularly distributed.

Because of the size of the dose—it takes 5 c.c. per kilogram of weight to opacify the femur of a rabbit—and of the fact that the method of elimination of the thorotrast is not as yet thoroughly understood, the method cannot yet be used in man. The author describes his technique and discusses the biological problems involved. He believes that elimination may be accelerated by irradiation with roentgen rays. —*Audrey G. Morgan.*

Whitman, W. G. Some observations of the effects of radium irradiation on tissue cultures. *Am. J. Cancer*, April, 1933, *17*, 932–945.

A study was made of the effect of radium irradiation upon (1) normal chicken fibroblasts and (2) to compare effects of irradiation upon tumor cells and macrophages in the same culture, using the change in number of mitotic figures as a basis of comparison.

Gamma rays were used and it was found that cells already undergoing mitosis proceeded to complete the process in a normal manner. Early changes in caryokinesis consisted in formation of pycnotic figures. The individual chromosomes were shrunken and frequently clumped. Aberrant chromosomes were characteristic. A marked lagging of the chromosomes during anaphase and telophase was noted, which might well have been due to injury to the spindle. The abnormal chromosomes were scattered throughout the nuclei in a haphazard manner. These changes eventually lead to the death of the cell or to an abnormal life cycle.

The studies of the effect of irradiation upon normal cells and tumor cells in the same culture

showed that mitosis was proportionally more reduced in normal macrophages than in malignant cells. The percentage of initial fall in mitotic count was greater in normal than abnormal cells, but the recovery occurred sooner in normal cells. These changes were noted with three different quantities of irradiation.—*J. H. Harris.*

GETTLER, ALEXANDER O., and NORRIS, CHARLES. Poisoning from drinking radium water. *J. Am. M. Ass.*, Feb. 11, 1933, *100*, 400–402.

The authors claim this to be the first reported case of fatal radium poisoning due to drinking water containing radioactive materials and proved scientifically. The patient had consumed about 1,400 two-ounce bottles of water, each said to contain 2 micrograms of radioactive substance. Extremely anemic and emaciated, he was found at autopsy to have necrosis of the jaw bones, swollen kidneys, cerebral abscess, aortic and coronary sclerosis and marked bone marrow hyperplasia. The various tissues were reduced to ash and tested for radioactivity both by electroscopic and photographic methods. All the bones were intensely radioactive, the soft tissues being less affected.

The use of foods and beverages containing such substances should be prohibited as being detrimental to health and eventually fatal.—*E. W. Hall.*

PALMIERI, GIAN GIUSEPPE. I concetti di "reversibilita" e di "irreversibilita" nella radioterapia dei tumori. (The ideas of reversibility and non-reversibility in the radiotherapy of tumors.) *Radiol. med.*, 1933, *20*, 716–724.

Reversibility is a biological conception that means that whole organisms or certain organs or tissues that have undergone pathological changes are capable of returning to a normal condition. There is a difference between reversibility and the possibility of cure, as the former is purely biological and not clinical. There may be clinical cure without reversion of the tissues to a normal condition and there may be at least local reversion without cure. There are all degrees from apparently complete reversibility to absolute irreversibility. There is a local and a general reversibility. There are cases of local irreversibility with general reversibility in which cure may be brought about by substituting some other method of treatment such as surgery or diathermic coagulation for radiotherapy.

The author concludes that radiotherapy properly applied may bring about apparently complete and permanent reversibility in some cases of tumor. Of course, the terms reversibility and irreversibility are relative and dependent on various factors, among them the technical development of radiotherapy. Coutard's method, for example, has demonstrated that reversibility is possible in cancer of the larynx, in which it was formerly believed impossible. Tumors that are reversible up to a certain stage may become irreversible later and it is important not to let the stage of reversibility pass before giving treatment.—*Audrey G. Morgan.*

STAHEL, E., SIMON, S., and JOHNER, W. Importance clinique des rayons béta secondaires en curiethérapie. (Clinical importance of secondary beta rays in radium treatment.) *Acta radiol.*, 1933, *14*, 227–248.

The authors give a theoretical discussion of the secondary irradiation emitted by the filters used in treating with gamma radium rays. They studied the relative importance of undulatory and corpuscular irradiation in roentgen and gamma irradiation.

The clinical significance of the secondary beta rays in radium therapy was studied by ionization methods, photographic measurements, a study of the skin reactions and the action of the rays on *Drosophila* eggs. The practical conclusions drawn from the physical and biological experiments are: (1) Filters of moderate atomic weight such as iron and silver produce the least intense secondary rays. (2) Because of the slight penetrating action of secondary beta rays, the use of secondary filters for irradiation through the skin is not necessary as shown by biological experiments on the skin and conjunctiva. (3) Filters of medium atomic weight are to be recommended for intratumoral irradiation, as shown by experiments on *Drosophila* eggs.—*Audrey G. Morgan.*

SIEVERT, ROLF M. The new apparatus for teleradium treatment used at Radiumhemmet. *Acta radiol.*, 1933, *14*, 197–206.

This article consists of drawings and a technical description of the apparatus for teleradium treatment recently installed at the Radiumhemmet in Stockholm.—*Audrey G. Morgan.*